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ABSTRACT

The nine conference presentations in these proceedings focus on educational technology and students at risk of school failure and include: (1) "Getting Underway" (Stephen S. Kaagan), which provides an overview of technology in society and the purposes of the conference; (2) "Technology Can Help Children Who Are at Risk of Student Failure" (John D. Bransford and Ted S. Hasselbring), which demonstrates that existing microcomputer and video technology can help at-risk students develop skills, knowledge, and confidence; (3) "The Use of Technology with Students at Risk" (Robert E. Blair and James P. Shea), which describes three programs in Canadian school systems that use technology in innovative ways for students at risk; (4) "The Student at Risk: A Demographic Perspective" (Harold L. Hodgkinson), which discusses trends and demographics that affect instructional technology; (5) "A Closer Look at the Student at Risk" (Richard R. Green), which considers the demographic, school, and personal/social characteristics of at-risk students; (6) "Technology and Students at Risk" (David W. Hornbeck), which examines the usefulness of technology in meeting the needs of at-risk students; (7) "Information Technology and the Schools: A Personal Perspective" (Marc S. Tucker), which discusses effective use of technology; (8) "Conference Synthesis" (Duncan Green), which summarizes conference ideas, principles, and recommendations; and (9) "Next Steps" (Stephen S. Kaagan), which suggests some future directions for the field. A summary of the conference, biographical notes on the speakers, and a directory of participants are included. (MES)

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Proceedings of the Conference on Technology and Students at Risk of School Failure

June 28-30, 1987
Pheasant Run Resort
St. Charles, Illinois

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Proceedings
# of the

Conference on Technology and Students at Risk of School Failure

The Conference was organized by the Agency for Instructional Technology
in cooperation with

American Association of School Administrators
Canadian Association of School Administrators
Canadian Education Association
Canadian School Trustees' Association
Council of Chief State School Officers
Council of Ministers of Education, Canada
National Association of State Boards of Education
National School Boards Association's Institute
for the Transfer of Technology to Education

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Foreword

This publication contains the texts of the presentations made at the general sessions of the Conference on Technology and Students at Risk of School Failure. It is hoped that conference participants, and those who did not attend, will find these pages useful in exploiting instructional technology for the benefit of students at risk.

Edwin G. Cohen

Edwin G. Cohen
Executive Director
Agency for Instructional Technology

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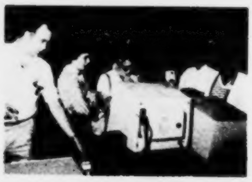

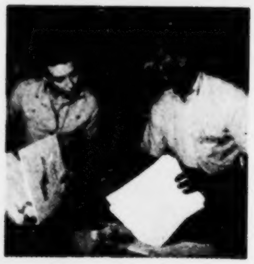

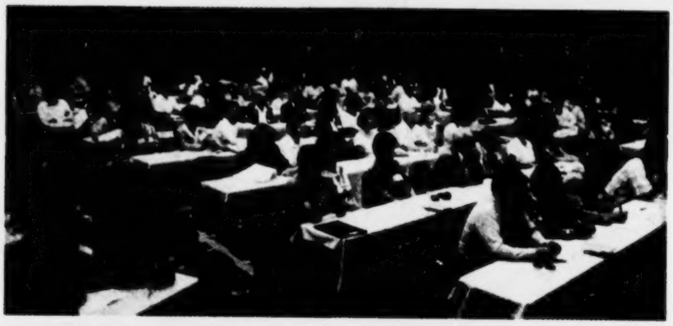

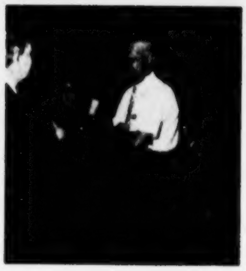

Summary of the Conference on Technology and Students at Risk of School Failure

Introduction

The Agency for Instructional Technology (AIT) has been developing learning resources for American and Canadian students for 25 years. As part of its silver anniversary observance, AIT organized a conference on technology and students at risk. It did so because of its commitment to strengthen the education of all students through technology and because of its experience in enabling provinces and states to develop commonly needed technology-based programming. The purpose and plan of the conference reflected two convictions: technology can be important in serving these students; and the problem is so widespread and formidable that it merits joint state and provincial attention.

AIT initiated the conference and conducted it in cooperation with the following American and Canadian educational organizations.

- American Association of School Administrators
- Canadian Association of School Administrators
- Canadian Education Association
- Canadian School Trustees' Association
- Council of Chief State School Officers
- Council of Ministers of Education, Canada
- National Association of State Boards of Education
- National School Boards Association, Institute for the Transfer of Technology to Education.

The conference was attended by delegations named by the chief school officers of 47 states, seven provinces, the Northwest Territories, the District of Columbia, and Puerto Rico. Representatives of 32 education organizations in the United States and Canada also attended, as did staff from nine commercial firms.

Speakers at the conference were

- Robert E. Blair, Executive Director, Canadian Education Association
- John D. Bransford, Director, Learning Technology Center, Vanderbilt University
- Duncan Green, Assistant Deputy Minister of Education, Ontario Ministry of Education
- Richard R. Green, Superintendent, Minneapolis Public Schools
- Ted S. Hasselbring, Associate Director, Learning Technology Center, Vanderbilt University
- Harold L. Hodgkinson, Senior Fellow, American Council on Education
- David W. Hornbeck, State Superintendent of Schools, Maryland State Department of Education, and President, Council of Chief State School Officers
- Stephen S. Kaagan, Commissioner of Education, Vermont Department of Education, and Chairman, AIT Board of Directors

- James P. Shea, Manager, Research and Evaluation, AIT
- Marc S. Tucker, Executive Director, Carnegie Forum on Education and the Economy.

What Was the Conference to Achieve?

While the general purpose of the conference was to identify ways educational technology could improve the educational performance of students at risk of school failure, Stephen Kaagan identified several more specific intended outcomes.

He anticipated that the quality of the deliberations would have an impact on the participants as they continued to carry forward their responsibilities. He asked each state or provincial delegation to consolidate its thinking and send AIT its ideas for top priority uses of technology to assist in the education of at-risk students. It was expected that, from the conference's presentations and group discussions, Duncan Green would formulate a preliminary set of principles for the development and use of educational technology and would identify barriers inhibiting such development and use. A written synthesis of the conference would be available to all participants and would be distributed widely throughout Canada and the United States. AIT staff and members of its board would present the ideas coming from the conference to the Council of Chief State School Officers, the Education Commission of the States, and several other American and Canadian forums. Finally, in response to needs identified at the conference and to the priorities subsequently received from conference participants, AIT intended to initiate at least one project that would yield video and computer software products for use with at-risk children in schools or community settings by 1990. The project would be developed by a consortium of states and provinces and might be assisted by funds from other agencies.

Who Are At-risk Students?

There is no generally accepted definition of who is an at-risk student. With the exceptions noted below, conference participants accepted the following statement.

"Students at Risk" are those who are

- one or two years behind grade level in reading and mathematics skills (K-8).
- three or more credits behind age/grade level in credits toward graduation (9-12).
- chronic truants.
- school-age parents.
- adjudicated delinquents.
- victims of personal and/or family, alcohol, or drug abuse.
- victims of family trauma such as death, divorce, violence, separation, or unemployment.
- victims of physical, sexual, or emotional abuse.
- students with limited English proficiency.
- victims of ethnic, economic, or cultural disadvantages.

While delegates accepted the idea that students from poor economic circumstances may be potentially at risk, they were reluctant to agree that all students from any particular ethnic or cultural background were in this category. Also, a substantial number thought special education students should be considered at risk. And some delegates felt strongly that inadequate or marginal teaching contributed to putting some students at risk.

In discussing the at-risk group, Richard Green provided these additional insights.

- There is a disproportionate number of blacks, Hispanics, and American Indians in the populations defined as at risk.
- Working at a regular job in addition to attending school places some students at risk.
- Substantial numbers of urban school children are characterized not by just one risk factor, but by several factors acting together.

Green cautioned the conference to avoid the common error of confusing association with causation. Significant numbers of students who meet the criteria for being at risk achieve very well.

Why Is the Issue of At-risk Students So Significant Today?

Richard Green pointed out that the presence of at-risk students in Canadian and American schools is by no means a new phenomenon. In the early days of both nations the presence of non-English speaking children of very poor immigrants was not unusual. The depression days of the '30s produced another group of at-risk students, as did the northern migration of black Americans.

There are, however, factors that make the current situation demand attention. Kaagan and David Hornbeck underscored the major contention in the *Carnegie Report on the Teaching Profession*— if the United States is to maintain its current economic status, it must develop 'smart' workers, because the United States cannot compete in the international marketplace by trying to work cheaper than others without major social, political, and economic turmoil. Harold Hodgkinson clearly pointed out the demographic changes that are taking place in the United States. Of particular significance is the fact that in five years, there will be only three people in the work force for each retired person on Social Security. One of the three will be from a minority group.

Thus, for simple economic reasons, it is imperative that large numbers of at-risk students be educated, 'smart' workers.

Equally important is the moral imperative. Although, as Hornbeck stated, "Historically we've had enough kids that we could throw some away," the notion of not being concerned with students who do not succeed either for reasons over which they have no control or for reasons they control is simply not in accord with current American or Canadian ideals.

A significant national priority, therefore, is to find ways and means to improve dramatically the educational attainment of at-risk students.

What Is the Current Use of Technology in the Education of At-risk Students?

With the assistance of the Canadian Education Association and the National School Boards Association's Institute for the Transfer of Technology to Education, AIT conducted a survey of schools in the United States and Canada to determine the uses of electronic technology in school programs or activities serving students at risk of school failure.

While numerous examples of the use of electronic technology are described in the publication *A Survey of the Use of Technology with Students at Risk of School Failure* (available from AIT), three are worthy of special note.

Superintendent Arvid Nelson of Indian Springs School District, Justice, Illinois, reports that with cooperative funding arrangements, computer-assisted and computer-managed instruction have been a factor in above-the-norm achievement with a population having a high percentage of at-risk students.

Escambia County School District in Pensacola, Florida, established a remedial reading program for high school students who are disadvantaged and below grade level in reading or mathematics. Using Computer Curriculum Corporation System software, the program achieved remarkable results—one month's growth in reading or mathematics for every hour the student spent on the system. A unique feature of the project is a performance-based funding contract with the Private Industry Council.

John Fraser, director of education of the Peel Board of Education, Mississauga, Ontario, reported an alternative program for students under 16 who have applied for and been granted leave from regular school attendance. The program, funded by the board of education and the Ontario Ministry of Education, had two goals—to enable the student to get a job and to encourage students to return to school. It used both television and the microcomputer.

These programs have three things in common.

- technology that offers children individualized self-paced learning;
- funding through innovative partnerships involving local, state, provincial, or federal agencies and private business; and
- an advocate—someone capable of envisioning possibilities and willing to work hard to make them happen.

In general, the survey found that

1. The computer is the predominant technology being used by schools to serve students at risk in both the United States and Canada.
2. Applications of technology were designed for a wide range of students, including adjudicated delinquents, non-English speakers, Chapter I students, and students who are behind grade level or deficient in mathematics or reading.
3. Technology was used in a wide range of curricular areas, including occupational/career training, remedial mathematics or reading, English as a second language, record keeping, language arts, and skill reinforcement. A number of computer applications were for record keeping or tracking student progress.

Overall, the single most consistent finding has been the preponderance of uses of the computer to address a variety of curricular areas for at-risk groups.

Can Technology Make a Difference in the Instruction of At-risk Children?

While several speakers referred to the potential of technology in general, particular emphasis was given to the microcomputer. David Hornbeck discussed the characteristics of microcomputer use that empower students. The microcomputer can motivate students and individualize instruction. In providing feedback it is patient and not judgmental. It gives the learner autonomy—a quality missing in the lives of many students, especially those at risk. With its immense memory, the microcomputer can provide simulations that are especially useful in mathematics, science, and social science instruction. Simulated experiences can supplement and, in some cases, replace laboratory work.

Both Hornbeck and Marc Tucker drew attention to the effectiveness of the Comprehensive Competencies Program in raising the basic skill level of young adults in a variety of settings—vocational schools, correctional facilities, job-training programs, and private sector work sites.

Kaagan argued that for technology to be used responsibly, those who develop and use it must exploit what is known about cognitive psychology—a point reinforced by John Bransford and Ted Hasselbring. Part of their work is based on research emphasizing the importance of fluency. As learners become fluent, their ability to proceed to complex tasks improves. If designed and used appropriately, drill and practice programs, which are often criticized, can play a significant role in improving fluency.

Current research also supports the benefits of learning in a contextually rich environment. Bransford and Hasselbring argued and demonstrated that microcomputer and video technology can be used to create a stimulating problem-solving environment in physical and social science and mathematics programs.

Tucker, Hornbeck, Bransford, and Hasselbring all presented strong cases, based on either research or belief, that a powerful use of the microcomputer is to enable students to become generators rather than consumers of knowledge, to be active rather than passive. Specific mention was made of word processing software, which makes revising and editing written work so much easier that students are motivated to write longer and more complex material with less attention to such matters as spelling and punctuation.

Hornbeck noted the specific advantages of technology in the education of disabled students. His examples included using word processors with special keyboards, generating large-scale print on a screen, and converting printed text to speech. He cited several examples of the effective use of technology with students who have limited proficiency in English. Hornbeck also observed the growing use of technology by many states and provinces to provide more effective distance learning programs to students for whom attendance at school is not feasible, or in small schools where limited numbers make offering specialized courses uneconomical.

Hornbeck emphasized the capability of the computer in the management of the educational enterprise. The computer is useful in planning programs for individual students, for schools, and for school systems. At the state or provincial level, student databases can produce powerful, policy-relevant information that is unattainable in any other practical way. To elaborate on this point he drew attention to the National Assessment Center Project of the Council of Chief State School Officers. While the project is controversial and politically risky, it has the potential to provide very useful information to state policymakers about the productivity of their systems.

What Are the Preconditions Necessary for Technology to Have a Substantial Impact on the Education of At-risk Students?

While many speakers and conference participants were convinced that educational technology has the potential to improve the education of at-risk students, there were strong views that the potential would not be realized unless certain conditions prevailed. Bransford and Hasselbring supported Kaagan's thesis that positive uses of technology must be based on an understanding of cognitive psychology. It was noted that while some good software is based on cognitive psychology, there is still a great unmet need.

Hornbeck concluded that because not many people have yet discovered a way to make money producing educational software, a broad-based and cohesive consortium approach may be necessary to drive unit costs down, shape content, and determine development priorities in line with the needs of schools and students.

Strong concern was expressed about the inability of the current teaching force and teachers now being educated to use available technology to good advantage. One participant suggested that an observer of most teaching practice and most teacher preparation programs would find little difference between the practice and programs of today and the practice and programs in place before the advent of television, let alone microcomputers. A massive program of in-service education is required, as is a massive reorientation of teacher education programs.

While conference participants generally shared the enthusiasm of the presenters with respect to the potential of technology to improve the teaching/learning process for all students and perhaps even more for at-risk students, many believed that more research was needed to establish that potential benefit could be translated into real benefits.

Hornbeck directly and Tucker indirectly raised the issue of equality of access. The poor are disproportionately represented among at-risk students, since most live in school districts where little money is available for their education. Hornbeck stated that there is a problem of inequality of access—a problem that needs to be resolved for reasons of both human decency and economic necessity.

Kaagan and Richard Green raised the possible necessity of reorganizing the educational enterprise to take full advantage of the potential of educational technology. Tucker went further. He asserted that without a major reorganization of schools, the impact of the computer would be the same as the impact of educational television—much rhetoric about possibilities and productivity, but little, if any, change in the education of children. To appear innovative, school systems, schools, and teachers would investigate the use of computers, but no substantial change would take place.

Tucker expressed the belief that if schools were reorganized so that the staffs were rewarded financially for meeting or exceeding performance standards, teachers would be motivated to use computer-based and communication technologies for what they are—tools that can increase productivity.

Conference Synthesis

After listening to the conference speakers, visiting discussion groups, and reading group summaries, Duncan Green concluded that the conference generated six main ideas.

1. Technology has a strong potential to improve both the actual process of instruction and its management.
2. Technology's potential applies to all students, not only to those regarded as at risk.
3. Students who are at risk may be identified too late—early intervention programs may prove more beneficial than programs introduced later in the students' school career.
4. Teachers are not well prepared to use technology. Widespread in-service and pre-service programs are necessary.
5. The effective application of technology has major implications for the organization of schools.

6. Technology can provide effective communication between individuals and agencies about students at risk.

Discussion group participants and some of the speakers addressed principles related to the use of technology. Duncan Green identified the principles put forward as the following.

- Technology should be used to empower students (not enslave them).
- Principles of good pedagogy should apply in the exploitation of technology to improve educational experiences. For example, students should be actively engaged in the learning process, as opposed to playing a passive role.
- Similarly, principles of good pedagogy should apply in the development of software.
- Technology should be applied in such a way as to increase positive relationships among students, teachers, and adults.
- There must be a commitment to the investment involved with respect to the introduction of technology (by state or provincial agencies and local boards of education). Technological applications must be seen as affecting the entire educational system, including teacher education institutions; the management of the educational enterprise at the state or provincial, local, and school level; and the actual teaching and learning process.
- The application and exploitation of technology should not be viewed as a panacea for improving the education of at-risk students—or any other students. Proponents of the merits of technology are advised to keep hype down and humility up.
- Equality of access to the benefits of technology must be assured.

In concluding his synthesis of the conference, Duncan Green offered these recommendations for the consideration of conference attendees.

1. Pre-service and in-service education must be provided on a massive scale to prepare teachers to exploit technology effectively. The process has to be a continuing one.
2. Teachers must be led gently to the use of technology, rather than having technology thrust upon them.
3. There is need for more research to validate claims that technological applications do make a positive difference in the education process (especially of at-risk students).
4. Software development should be undertaken in close cooperation with teachers of at-risk students and with local curriculum authorities.
5. The issue of adequate resources must be addressed.

Next Steps

Stephen Kaagan emphasized that the following actions are being taken to continue the impetus generated by this conference to improve the educational program for at-risk students through technology.

1. In September 1987, printed proceedings of the conference will be sent to all participants and to others upon request. It will include the conference summary, the text of all presentations, and a list of participants and presenters. In addition, a video version of the proceedings will be available.

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2. The conference summary included in the proceedings will be reprinted in the August 1987 *AIT Newsletter*, which will go to more than 22,000 American and Canadian educators.

3. AIT staff and board members will be discussing the issues raised at the conference with American and Canadian education agencies, with a view to initiating policy-oriented action to meet the needs of at-risk students.

4. In September 1987, each state and provincial delegation is asked to provide AIT with a statement of its views regarding top priority uses of technology in the education of at-risk students.

5. The staff and board of AIT, assisted by the conference proceedings, the responses from states and provinces, and input from other agencies and individuals, will explore the development of products for at-risk students, to be available by 1990. This exploration will include funding partnerships with private and public agencies as well as with states and provinces.

Mr. Kaagan concluded the conference by reminding participants that technology is useless without the will to use it.

This conference summary was prepared by James S. Hrabi, President, Canadian Education Association, and Vice Chairman, AIT Board of Directors.

Stephen S. Kaagan
Vermont Commissoner of Education,
Chairman, AIT Board of Directors

Getting Underway

To begin this conference on the uses of technology to serve the needs of at-risk students, I want to take you back 500 years. In 1491, Peter of Ravenna, the writer of a popular handbook, claimed some early success in creating a thousand-ram memory bank. In an account of this invention, Daniel Boorstin, in that wonderful book *The Discoverers*, has written

> Peter...advised that the best memory *loci* were in a deserted church. When you have found your church, you should go around in it three or four times, fixing in your mind all the places where you would later put your memory-images. Each locus should be five or six feet from the one before. Peter boasted that even as a young man he had fixed in his mind 100,000 *loci* and by his later travels he had added thousands more. The effectiveness of his system, he said, was shown by the fact that he could repeat verbatim the whole canon law, two hundred speeches of Cicero, and twenty thousand points of law.[1]

Peter, you might agree, came close to being a complete computer. Storage, retrieval, and display were all inside his head. His system was remarkably compact, and a lot less than $1995 delivered and installed. Peter, thanks very much for the memories. We appreciate them.

Between 1491 and today, indeed, much has happened. From the mental technology of the Peters of Ravenna and those of his generation who practiced his art, through the dominance of print, and then on to moveable type, we have progressed to video, to large sized computers side by side, and now have arrived at the versatile and portable micro CD-ROM and videodisc. Looking back over the last five hundred years, we almost get the same sense that one gets in looking at that wonderful *New Yorker* cover in which New York City is implanted and everything beyond Ninth Avenue is compressed. We have the same sort of compression— not spatial here, but temporal, in terms of what has happened in the information age over the last ten, twenty, thirty, or forty years. A profound myopia, though, might be inherent in both the *New Yorker* cartoon and what has happened to us.

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[1] *The Discoverers* (New York: Random House, 1983), 484. Peter of Ravenna's handbook was called *Phoenix, sive Artificiosa Memoria* (Venice, 1491).

Over history, therefore, we see a progression. The human mind develops mechanical models of its own workings outside of itself, and large chunks of what was inside Peter of Ravenna are now outside the human body and the mind—in books, film, video, and magnetic memory. I think you will agree that the results of this progression have been astounding indeed, but that we are also still trying to decipher our relationships with that which, once having been inside of us, is now beside us. We are, if you will excuse the expression, quite "beside ourselves" over this transition. Every time we sit down and dwell upon this confusion, several contradictions about where we stand as a civilization come to mind. Let me just mention three.

First, advancements in technology have raised us to great heights of human responsibility, but they have also lowered us, in some sense, to unprecedented levels of irresponsibility. Henry Miller, whom I dearly love, in a book called *The Air Conditioned Nightmare*, describes America after WWII, the America that he saw upon returning from Europe. He says "whatever happens to this earth to-day is of man's doing. Man has demonstrated that he is master of everything—except his own nature." He says later on in the same paragraph that "destruction now is deliberate, voluntary, and self-induced."[2]

Secondly, technology has given life great material and spiritual fullness. But at the same time it has contributed to a deep sense of emptiness and meaninglessness. When asked repeatedly why he did what he did in his work, Picasso summed up modernity by saying, "The world doesn't make any sense; why should I paint pictures that do?"

Third, while technology has spread information across the breadth and depth of the human landscape, it has also detracted from our mental resourcefulness, and created an almost rampant empty-headedness. How many of us today can boast of the resourcefulness of Peter of Ravenna? Compare his mind to those of children who with blank faces sit for six or more hours before a television set.

So, let all of us here in this room today, at least somewhat humbly, acknowledge at the outset that while we seek in technology a partial solution to the problems we face, including those addressed at this conference, technology itself is a part of those problems.

On to the purposes of this conference. Lewis Thomas, a wonderful scientist and writer, makes an important distinction between technology and science. He says, "Science is useful, indispensable sometimes, but whenever it moves forward it does so by producing a surprise; you cannot specify the surprise you'd like." To work, he says, it must be "given its head." Technology, on the other hand, should not be given such free reign. Thomas says it "should be watched closely, monitored, criticized, even voted in or out by the electorate."[3]

The real purpose of this conference is to exploit the distinction that Thomas is making between science and technology. We must become responsible in the deepest sense about the uses of technology, while at the same time deepening our commitment to scientific thinking. We must monitor, criticize, and vote in or out the technology that comes to our attention, and turn our considerations of what technology should be used for into the most sophisticated of sciences.

No group—no group—deserves the focus of our efforts more than those who are in some ways the victims of technology's successes—those young people who are at risk of school failure. Our job in this forum is to set before ourselves an image of these students and to bring into sharper focus alongside this image an awareness of the risk that they carry for themselves and for society. With these images before us, we have to address the bedrock question of this conference: what can technology do to help them?

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[2] *The Air Conditioned Nightmare* (New York: New Directions, 1945), 175.

[3] "Making Science Work" in *Late Night Thoughts on Listening to Mahler's Ninth Symphony* (New York: Viking, 1983), 29.

Marc Tucker, who will speak to you soon, is fond of beginning his presentations about the Carnegie Report on the teaching profession by citing a story. He says that the Carnegie Report begins at the Samsung Electronics Plant south of Seoul, South Korea, where the workers work up to 363 days a year, ten hours a day, for less than 350 dollars a month, producing the electronics equipment that was once the hallmark of our advanced civilization. Tucker goes on at the end of this preface to say that we really have two choices in this country, or on this continent: One, we can lower our wages and compete at the same level with the South Koreans; or, two, we can work smarter and compete at a higher level. Tucker contends, and I'm sure you'll agree, that our only choice is to work smarter. His story suggests something we must be aware of, which is that we are all at risk– all of us, Canadians and Americans alike.

It would be a serious mistake for us to forget this sobering fact at any point in our deliberations. But we also must agree that we are especially at risk if, given their present situation, a large proportion of our school-age population cannot become smart workers. To put it most bluntly, what has been until recently a moral imperative for our societies, to help those **less** able to become **more** able, has now acquired the urgency of economic survival. Bud Hodgkinson, whom you will hear tomorrow, says it most simply: for each of us who reaches sixty-five years of age, there will be only three people in the work force to pay for your Social Security pension and mine. One of these three will be from a minority ethnic group, and one out of four will be a high school dropout.

It causes pause for consideration. How ironic it is, in some sense, that all of the discussions of the last ten to fifteen years about four-day workweeks and the consequences of increased numbers of days of leisure time have evaporated from consideration. The question of what to do with excess leisure time has evaporated in the last third of this century, and North American manufacturing dominance has faded with it. No other evidence speaks so forcefully of the shift in society's priorities.

But most specifically, who are our at-risk students? Let me just cite for you the list that has generally been agreed to by a large number of educational organizations. They are dropouts, or potential dropouts, burdened with a variety of social and academic and economic problems. They are behind grade level in school and often limited in their command of English. They are likely to be chronically truant. They are teenage parents, victims sometimes of family trauma, poverty, and cultural deprivation, and they may be all too well acquainted with drug or alcohol abuse. They have very little potential, at least for now, for developing into the smart workers called for by the Carnegie Report.

Some estimates put the number or proportion of at-risk students in the school-age population at about 33%– a significant number of those that we are supposed to be serving. Based on the data that they have gathered, some analysts from the Educational Testing Service have argued that there are two groups particularly at risk of school failure if they do not receive educational attention, based on the data that ETS has gathered. These are the children and young adults who are members of particular minority groups (especially black and Hispanic) and those who lack home support for literacy regardless of ethnic background. Actually there is an overlap between these two groups.[4] One could ask, as many have even in the last couple of hours, "How did all of this happen? How did we arrive at this point with so many at-risk students? Were they there before? Is there something going on that we ought to be aware of?"

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[4] Data from the National Assessment of Educational Progress Young Adult Literary Assessment indicate that these two groups are particularly at risk for school failure if they do not receive educational attention. See Richard L. Venezky, Carl F. Kaestle, and Andrew M. Sum, *The Subtle Danger: Reflections on the Literacy Abilities of America's Young Adults* (Princeton, NJ: Educational Testing Service, March 1987).

I have struggled with these questions, and though I have no definitive answers, I have come up with a brief paradox—I tend to think that paradoxes have a lot to say about our life—which might begin to suggest some answers: Technological development brings about economic success and rising expectations about the quality of life. Yet while it encourages economic vitality, technology also brings a certain moral and intellectual vacuity—an emptiness, if you will—which ensnares ever larger segments of our society, effectively depriving them of any opportunity to produce or to enjoy the products of a technological civilization. Ultimately, of course, as fewer and fewer are left who have the skills to survive in tomorrow's world, productivity will fail, the standard of living will decline, and other competitors will prevail. It is not a pretty picture, if you believe any of its essence.

The Educational Testing Service, again, adds dramatic impact to the picture by saying, in effect, that prevailing

> literacy skill levels...are not adequate, on average, for maintaining world leadership in a changing, technological society at the end of the twentieth century. America's labor market, its military, and its political and economic processes require citizens with relatively high levels of critical thinking/reading skills. [Our changing society]...requires citizens who can adapt to change, whose literacy skills allow them to master new jobs, new economic structures, and new political structures.[5]

The ETS work that I am quoting from, *The Subtle Danger*, provides a disturbing statistical comparison. It says that in the United States the mean scores on literacy skills tests of black graduates of four-year colleges, as opposed to white high school graduates, compare at about the same level ETS says that "the latter group," that is, white high school graduates, "performs nearly as well as the black college graduates even though they have had four years less schooling."[6] Let this conclusion sink in for a minute. Black college graduates perform about as well as white high school graduates in basic literacy skills. That is a direct quotation from *The Subtle Danger* by ETS. If there ever was social tinder, political dynamite, and economic acid, this is it; and, it is the challenge that confronts us.

So, given this image of at-risk students, the question for us here at this conference remains: what is the role of technology in improving the educational status of students at risk? To provoke your thinking a little bit, let me dwell briefly on one attitude which I find completely irresponsible. It comes from a *Washington Post* article, but it really speaks to much of what we have read within the last couple of years. Steven Frankel wrote this in the *Washington Post* recently.

> The technological revolution in education is finally at hand. Schools ten years from now will be explosively different from the ones today. A new combination of existing products, microcomputers, compact disks, adaptive tests, satellite communications, and artificial intelligence will

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[5] Richard L. Venezky, Carl F. Kaestle, and Andrew M. Sum, *The Subtle Danger: Reflections on the Literacy Abilities of America's Young Adults* (Princeton,NJ: Educational Testing Service, March 1987), 7.

[6] *Ibid.*, 32.

> produce the first technological revolution this century that educators will not be able to ignore.[7]

I love that last line—"that educators will not be able to ignore." Frankel's contentions, I believe, are utter pipe dream, total illusion, almost drunken in a sense. His view of technology comforts us when we have to deal with some extremely difficult problems, but it does not solve a single one of them. Contrast Frankel's view with that of a much more sober analyst, David Cohen, who says,

> Nearly all of the new technologies pressed on schools since World War II from paperbacks to microcomputers have been advertised as agents that would change education by making students less dependent on teachers and by reducing whole class, lock-step, batch-processed teaching and learning. Americans persistently dream about the liberating effects of technical innovations. There is a St. Simonian, almost utopian, quality about these hopes, a sense that technology itself can break the chains that bind us to a dreary, work-a-day routine.[8]

But you and I both know that "possibilities alone will not drive social organizations to realize them." [9] Bringing about possibilities requires creating a whole new set of incentives, new pressures, a different form of leadership, and a willingness and a commitment to reorder our workplace—the school—to accommodate the tools that we have in them. Technology, of course, is nothing more than a tool. That has been said so often. It cannot drive social change; it can **enable** change, but it cannot drive social change. What I am calling for here in your work, in your deliberations, is a responsible use of technology in the schools. One that will require two major adjustments on our part.

First, I think we have to begin to refocus on what is inside the black box of the mind and the black box of the educational business **before** we think in the utilitarian sense about the uses of technology. Peter of Ravenna, you will remember, was someone fixated on the uses of what was inside. We have something to learn from him, but I think we have to go beyond him as well. We have to get beyond simple equations of knowledge equals facts, that learning equals accumulation of facts, and that teaching equals the telling of facts.

In order to get beyond those things, I believe we must draw more from the science of cognitive psychology than we have before. We must draw more from the thinking of a variety of people who have looked at the school organization and who have made commentary on it, from Mortimer Adler to Theodore Sizer to John Goodlad. We must begin to get at the need for some fundamental changes in pedagogy and in the way that the schools are organized to provide for students' learning.[10] Foremost then, among our adjustments, is a need to refocus on the business of the mind and the education business itself and to think through the changes that need to be there before, in some sense, thinking about the uses of technology.

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[7] "Finally, the Revolution in Teaching." *The Washington Post*, 23 Nov. 1986, Outlook section.

[8] *Educational Technology: The Next Generation of Policy and Research Issues*, Center for Policy Research in Education Monograph, Eagleton Institute (New Brunswick, NJ: Rutgers University, Nov. 1986), 16-17.

[9] Cohen, 17.

[10] Mortimer Adler, *The Paideia Proposal: An Educational Manifesto* (New York: Macmillan, 1982). Theodore R. Sizer, *Horace's Compromise: The Dilemma of the American High School* (Boston: Houghton Mifflin, 1985). John J. Goodlad, *A Place Called School: Prospects for the Future* (New York: McGraw Hill, 1984).

But having articulated and redefined education's ways and means, we must, as a second step, exploit existing technologies as best we can. It is probably realistic, for the moment. This is a tough pill to swallow—to downplay the potential of frontier technologies and resist solutions that have been neither validated nor established. The fully computerized classrooms or versions of it, or versions of other frontier technologies, are examples. I think we should observe what Lewis Thomas has to tell us in the distinction between science and technology and we should lower our sights for technology's potential and raise them for science's potential rather than the other way around.

I think, in some sense, we have been doing just the opposite. We have moved all our expectations for betterment over to technology and have stripped science to an empty hall. Instead, let's rely more on our science, the sciences of cognitive psychology and organizational analysis and what we have to learn from them in an applied sense. For now, at least, let's not go overboard in thinking that a solution to our problems lies in experimental technologies. Our classrooms will move ahead productively, I think, if we can just realize more of the potential that already exists in the technology of the video, the microcomputer, and, lest we forget, the technology of the book. So we must all, I think, look at technology with an eye that is both appreciative and apprehensive. We should turn to its offerings with a very real help that it can give us, but always from the perspective that its tools, however wonderful in themselves, must always conform to our wisest vision of what our school should be and what they must provide to every student entrusted to them.

Specifically, what sort of yield do we expect from this conference? What do we expect to get out of it? What do we expect from you? Let me quickly cite six things which I hope will stay with you over the course of your deliberations. First, there will be a written synthesis of the major themes and the ideological threads that resurface, surface, and resurface again in the presentations and discussions that take place here. The video product, some of which you will see tomorrow, will also become part of the permanent record of this event. But I think that it's important to know that there will be a permanent record of this event.

Second, I think it's possible that there be derived out of the work here a set of principles from the work and the ideas of the conference presenters, from your discussions, and particularly from the synthesis that will be written. These principles should be more instructive than what has been written to date about the effective uses of technology in schools. They could even become *desiderata* for schools, school communities, teachers and students. And they will be especially oriented, and that is what will make them unique to the needs of at-risk students. These principles may also suggest of incentives for using technology to redefine educational aims and redefine major barriers that stand between us and the more fruitful uses of technology.

Third, based on what you learn here, AIT asks that by September you submit in writing your ideas, as a state or provincial delegation, on the top priority uses of technology to assist with the learning of at-risk students within your jurisdictions. You will begin that here, but we hope that by September your ideas will be more refined and of greater use to us. Your thoughts will help us. The Staff and the Board together will determine how to proceed with specific product development.

Fourth, AIT intends to engage in product development in actual projects out of the work of this conference. We will aim to achieve at least one project that will yield video and computer software products for use in the schools or other educational settings with at-risk students. The project can be developed either by consortium, which is AIT's traditional mode, or with third-party support, which is increasingly likely on an issue of this magnitude. By 1990, I hope that students at risk will begin to benefit from these products.

Fifth, I fully expect that the results of our endeavor here will fit neatly into the work of the Council of Chief State School Officers, the Education Commission of the States in the United States, and several other American and Canadian forums as well, as these organizations see what can be done on a continental scale to deal with the demanding problems of at-risk students. A draft of the synthesis of ideas from this conference will, for example, be presented at the Summer Institute of the Council of Chief State School Officers, and I anticipate that the members of the AIT Board will also join a variety of organizations in their annual assemblies to present the findings of this conference and the results of the state and provincial plans that emerge in September.

Sixth, and finally, I expect that the quality of the deliberations of this conference will have an impact on the behavior of all of us as we go home and deal with our responsibilities for the education of students on the state, provincial, and local level.

Let me sum up. Peter of Ravenna, Henry Miller, Lewis Thomas, and David Cohen—these men make an odd combination, but nonetheless they express similar aspirations for humanity. And they also share, implicitly, a sense of the dangers confronting us. Not that much has changed in 500 years. Today, humanity faces really calamitous perils, hazards that we may alleviate if we are only a little wiser and a little more responsible in using the tools that we have been so ingenious to create.

Therefore, try at this conference to act like Peter of Ravenna. Focus your memory loci alternately on the science of human development and then on the promise of the newest technologies. **In your mind**—not on a hard or floppy disc, not on a perforated printout—fix the schema of organizational patterns of today's schools. And then, superimpose on that setting an image of the subject of this conference, the student who is failing, effectively illiterate, unskilled, disaffected. Then, with your mind fully loaded, not your bloodstream or your belly, but with your mind fully loaded, call up your stored memories and put those megabytes to work. Launch some useful products for the future, for your state or your province, and for the young people—our heirs—on this continent. Thank you very much.

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Technology Can Help Children Who Are at Risk of School Failure*

John Bransford

It's a pleasure for us to be here. A conference focused on children who are at risk of school failure is particularly important for us because it represents the primary mission of George Peabody College at Vanderbilt and of Peabody's John F. Kennedy Center. And, as you'll see, a number of our Peabody and Kennedy Center colleagues have helped shape the presentation that we'll make today. Our major goal this morning is to show that existing, off-the-shelf, microcomputer and video technology can help at-risk students develop the skills, the knowledge, and the confidence necessary to function effectively in today's complex society. However, we also want to emphasize that technology by itself cannot solve our problems; it has to be used effectively. As Stephen Kaagan emphasized last night, in order to use technology effectively, we need information from the scientific study of cognition, instruction, and culture. So, throughout our presentation, we'll relate our discussions of technology to the research literature in these areas.

Our presentation this morning is divided into three parts. First, we are going to provide some historical and theoretical background about cognition, instruction, and culture. Second, we'll illustrate some successful uses of technology to increase academic achievement. Here we're going to focus on three areas: 1) the importance of developing fluent access to knowledge and skills; 2) the importance of developing integrated knowledge structures that provide support for subsequent problem solving (this is very different from just learning sets of facts that remain inert); and 3) the importance of looking at students as producers of information rather than mere consumers. Finally, we'll end with some recommendations about the next steps that might be taken in order to utilize the technological potentials that now exist.

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* This presentation was assisted by Laura Goin and Susan Williams of the Learning Technology Center, George Peabody College for Teachers, Vanderbilt University.

Let me begin by providing some historical and theoretical background for discussions of technology. I noted earlier that our approach to education and technology has been shaped by the fact that we are at George Peabody College at Vanderbilt, and that a number of our colleagues there have had a strong impact on our thinking. One person, in particular, has been very influential for us, and we want to introduce her to you. Her name is Dr. Susan Gray, and she's a pioneer. Her early training project in the 1960s was one of the precursors of the Headstart movement. She graciously agreed to share some of her wisdom with us as we prepared for this talk. And we want to share some of it with you. Her project began with a group of forty four-year olds from extremely low income families in the South. Here is her description of her project.

Dr. Susan Gray (on video)

We began the actual program in the summer of '62 and continued the program with the children through the first grade. Since then we have basically followed up, rather than had any intervention.

John Bransford

The intervention involved prereading and other school-related activities, plus extensive work with parents. The four-year-olds continued in the program each summer throughout the end of first grade. As Dr. Gray just explained, after that the intervention stopped and the researchers followed up. The follow up is still ongoing. Dr. Gray's students are now twenty-nine years old and have children of their own. There are several findings from her studies that are important. For example, she found large differences between the experimental and control classes with respect to assignment to special education. Thirty-three percent of the control students who didn't have any preschool were assigned to special education classes by the time they reached middle school. In contrast, only 2% of the experimental group were assigned to special education classes. She also found that students in the experimental group, especially the female students, were more likely to finish school.

The most noteworthy point we got from her, though, is that despite several indicants of success, Dr. Gray emphasizes that more can be done to help at-risk students than was possible in her training project. In explaining why, Dr. Gray helped us realize the dangers of implicitly accepting what we will call an inoculation theory of intervention. What this means is that there are not one, or two, or three specific experiences that will inoculate children against school failure. Instead, academic development, as Dr. Gray argues, is an ongoing process. Her early intervention program set the process in motion. It increased the children's desire to learn and their courage to try new things, (what might be called their intrinsic motivation). This affected the teachers' reactions to the children, which in turn affected the children, and so forth. Dr. Gray refers to these effects as "transactions."

Dr. Susan Gray (on video)

Reciprocal interaction and transaction go on—and the children try harder and the teacher likes it even better, and they like the teacher and what she provides even better, and so on. It's a mutual-benefit effect.

John Bransford

An important implication of the transactional position is that transactions must be actively maintained. It follows that our efforts to help at-risk students will be strongest if we think not of one or two or three specific technology-based interventions, but rather of improvements in the processes of learning that take place throughout the entire range of preschool and school years. It's easy to forget this. It's easy to become overly enthusiastic and assume that Logo programming is the answer in the first grade or that word processing and spread sheets are the answers in the middle schools. All of these things can help. As Dr. Gray urges, we must focus on transactions over time. Anything we can do to develop intrinsic motivation— to develop the desire to learn and the courage to try— is important for strengthening the transactions that occur.

In addition to developing intrinsic motivation, Dr. Gray emphasizes the importance of developing cognitive skills and organized sets of knowledge. In the last ten years, cognitive research has exploded. We've begun to get a much better idea of the nature of successful performance and how it develops. This research is relevant for understanding why some people have more difficulty than others in academic tasks and for helping those who find the going tough. Much of the research in cognitive science explores the processes that underlie effective problem solving. For example, what makes effective thinkers and learners so effective and how can others develop these skills.

Some researchers have focused on general aspects of problem solving such as defining and representing problems, evaluating outcomes, and so forth. These are clearly important, but it has also become clear that general problem solving strategies are only part of the story. Cognitive scientists are beginning to see that effective thinking and problem solving also require a great deal of specific knowledge, and that this knowledge must be accessed with fluency. Otherwise, our limited attention becomes overwhelmed. Researchers have thus started to carefully study and compare experts in various domains— experts in chess, experts in physics, experts in bridge, experts in computer programming. In each of these domains, it is clear that one really important thing is the rapid recognition of familiar patterns. And I emphasize "rapid." The recognition must be almost effortless. Without this ability there is too much complexity to manage and we're overwhelmed.

I think I can illustrate this by showing you a video example of an expert we work with. This particular person is a houseboat expert. The guy on the left sells houseboats, and he knows something about them. The guy on the right is helping us with the experiment. This is an honest experiment. We actually ran it. The guy on the right is going to say, "I have a chance to buy a 1980 Gibson houseboat with all the options. I've got a little piece of tape here that shows it. Will you look at the tape and tell me if this is a good deal?"

Voices on Videotape

...1980 houseboat. It's got all the options. As a matter of fact, I've got a tape here I want you to see. Would you check it out for me?

Sure will.

John Bransford

All right. And the next thing you'll see will be about ten seconds of a videotape of a houseboat— exactly what the expert sees. See what you notice about this.

(10-SECOND PAUSE FOR VIDEO)

Okay, and then let's see what the expert noticed.

Expert (on video)

It looks like it's possibly older than a 1980 Gibson, due to the window design and the sliding door setup. It does not have all the options. It does not have a flybridge. It has gas instead of electric appliances because it has the twin gas bottles on it. Secondly, it looks like there's been some damage to the rails because it does not have standard Gibson rails. And based on the sheen and everything, it looks like it does need to be repainted.

John Bransford

As I said, it's an honest experiment. And it's really quite good. He noticed a lot of things. Now, obviously, if you're a total novice you don't know what to look for, but even someone who knows something about houseboats couldn't do it in real time if he weren't fluent. If you froze the frame and let him sit there and laboriously think through all the things that should be on a 1980 Gibson houseboat, he could effortfully do that, but it would demand a lot of attention. And as we become fluent, we're able to do these things relatively automatically. This in turn frees our attention for higher-level kinds of things and lets us start problem solving on a higher plane. Another example that you're all familiar with is when you first learned to drive a car. When you first learn to drive a car, you have to laboriously attend to pushing the clutch and brake and turning the wheel. You cannot do that and carry on a conversation at the same time. As you become fluent, you can start to carry on a conversation and drive.

Let me show you one other illustration of the importance of this rapid, fluent access to knowledge. This demonstration was prepared for us by Dr. Walter Schneider of the University of Pittsburgh. He's one of the leading experts in the world on controlled versus what is called "automatic" or "rapid-access processing." We're really grateful to him for preparing this demonstration. This is a little search task. You're going to see a bunch of words and numbers. What I want you to do is look for either an animal or a vehicle and as soon as you see something that names either an animal or a vehicle, with your right hand just hit the table like this, as quickly as you can. Okay? Let's go through this task. Animal or vehicle.

(VIDEO BEING SHOWN. NO DIALOGUE. TASK BEING PERFORMED BY AUDIENCE.)

All right. Most of you saw the word donkey. Now we are going to use your left hand for another task. In this next task we are going to search for either the number seven or the number four, and if you see either a seven or a four, with your left hand please hit the table. Okay, go ahead.

(VIDEO BEING SHOWN. NO DIALOGUE. TASK BEING PERFORMED BY AUDIENCE.)

Okay. That was just warm up. Now we'll do the real task. What I want you to search for this time is either a three or a nine. If you see one of those, use your left hand to hit the table. If you see an animal or a vehicle, and if you see one of those, use your right hand to hit the table. They'll come just slightly faster. Okay? So if we can show this.

(VIDEO BEING SHOWN. INTERJECTIONS BY BRANSFORD.)

Well, not bad. Let's try one more. It's not bad at all. This time look for either a nine or a one, and if you see that, hit with the left hand; if you see an animal or vehicle, hit with the right hand. Let's go with that.

(VIDEO BEING SHOWN. INTERJECTIONS BY BRANSFORD.)

Good. Hey! Not bad at all. Now one thing you can ask yourself is how easy it would be to be perfect in this task when you are looking for both numbers and animals. Most people would assume that it's not easy. Some would assume that it might be easy for others but it's really difficult for them. What Walter Schneider tries to emphasize is that a task like this one may initially seem extremely difficult but can, with the right amount and right kind of practice, become easy.

Let me show you some data he has collected. When you start out, look at just the very top there. This is where people are looking for only a single target, either an animal or a vehicle. With just a little practice, they can do that and on each trial are correct. But now look at the left at what happens when I add another task and divide peoples' attention. I not only asked them to do animals and vehicles, but also to do the numbers. You see that initially their performance falls way below 60%. At this point many people say this is beyond them. With a number of practice trials—in this case it takes about five hours of practice—they are, however, able to do this search task almost effortlessly. Schneider notes that many people are extremely surprised at their ability to do this, given how difficult it seems initially.

Let me show you another example where this has really come up for him. Schneider has studied electronic troubleshooting, in which, to find out why an electronic circuit doesn't work, the subject has to be able to read these diagrams and know which ones are AND gates and which ones are OR gates and what the particular properties of each of these are. This task demands considerable attention because the troubleshooters repeatedly have to stop and ask what the AND gate does, what an OR gate does, etc. Their attention is so overwhelmed in that task that they lose their place. Schneider started to work with people on this task and found some very interesting results.

Those who, after about an hour, were most likely to say that this task wasn't for them tended to be women; many said it was a man's task, that they could not do this kind of thing. Schneider would tell them to trust him, to stick with the task, to practice for the ten hours it would take to be able to do the basic components of the task automatically. He said amazing things happened. Those who gave themselves the chance to break through this barrier of clumsiness discovered they could do things that they had not been able to do before. Schneider was paying people to do this experiment, but one woman said, "Please don't stop. I'll pay you to continue. I love it." Another woman said, "You know, I'll just come for free, no problem." And, in fact, the women in his study who initially had thought that they could not do the task tended to be the best troubleshooters after about ten hours of practice.

The point Walter Schneider makes is that too often we, as teachers, and we as individuals, do not give ourselves the chance to push past the bottleneck that each of us encounters when first learning a new skill. When we do not give ourselves the time to develop this fluid access to certain patterns, our attention is overwhelmed. The task seems beyond our capacities.

We're going to discuss other aspects of cognitive theory later, but we want to begin our discussion of technology by focusing on this issue of fluency. It is extremely important but often underappreciated. Ted Hasselbring and Laura Goin have been directing a research project in Nashville that looks at fluid performance in the area of mathematics. What impresses me most about Ted's and Laura's work is the careful attention in research to guide the software design. Ted will tell you about that.

Ted Hasselbring

John's too kind. He's also a major investigator in this research; he just doesn't talk about it. John presented several examples of fluency in nonacademic tasks, showing how important it is. We think that fluency is important in virtually everything we do but especially in academic tasks. Take, for example, the task of reading. Students who read along trying to sound out each word as they come to it have no idea what they have read by the time they get to the end of a sentence. The same is true in spelling. If students are trying to do creative writing but are having to stop to recall how to spell each word, their attention is overburdened and they are unable to do the writing task. We think the same is true of mathematics. If students must constantly calculate answers to basic math facts, they have difficulty when they go on to higher-level skills.

We firmly believe that fluency in basic math skills is a necessary condition for achievement in mathematics. As John pointed out, for the past three years we have been conducting a series of research studies that have examined several issues related to fluency in basic math. The students that we've worked with have all been identified as learning-handicapped students and have been placed in resource-room settings, primarily in Nashville, Tennessee. These students have all experienced some kind of school failure. For our research, we have defined "fluency" as "effortless, errorless, and automatic retrieval of basic math facts from memory." As you'll see in a minute, the students in our studies are far from being fluent. If math computation were a measure of literacy, all of these students would be considered illiterate.

Let me give you an idea of the fluency problems that the students we work with exhibit. The students that you're about to see are engaged in a simple assessment task. A single-digit addition problem is going to come up on the computer screen; the idea is for them to supply the answer within ten seconds. The first student you're going to see is Jeffrey. I think Jeffrey is about eight years old. Let's go ahead and look at him.

(VIDEO BEING SHOWN. HASSELBRING INTERJECTS COMMENTS.)

What you are seeing Jeffrey do here is interesting—he touches his head to set his counter. For example, if the problems is three plus five, he touches his head with one hand and says "three" and then counts the remainder of the problem on his other hand. This is not uncommon, by the way; we see a lot of kids using body parts—we get nose counters, cheek counters. Jeffrey is not exactly fluent, but he does have the algorithm down. The next student we're going to see is a bit older. We might assume that as students get older that problem of counting on fingers goes away. And it does to some extent. But, as you see, Barbara is still a counter. She doesn't touch her head to set her counter, but she uses the same model: she says the first number and counts the rest on her fingers. Antoine, the last student you're going to see, was given a word problem. We asked him, "If you had three quarters and we had six quarters, and we gave our quarters to you, how many would you have altogether?"

(VIDEO CONTINUES.)

Antoine (on video)

Nine quarters.

Ted Hasselbring

All right. He got it, nine quarters. I would hate to see how long it would take him to figure out how many dollars and cents he had. What you can see from this is that the task requires a conscious effort from all these students. It's not automatic. It's something that they have to work at. The problem with counting such as this is that students get confused and often make errors. This affects their attitudes toward mathematics. It affects their attitudes toward themselves. They don't like having to rely on counting with their fingers. They are embarrassed by it, and they often become very frustrated. Here's an example of a student doing the same task. I think you can see the frustration.

(VIDEO CONTINUES.)

He ran out of time and couldn't solve the problem. Here's another one, using a number line. He gets it wrong. We often see this reaction among these kids. They really hate this assessment task when we first start out because it is terribly frustrating. It requires a lot of effort, and they simply don't like doing it.

One question we asked was, "how serious are fluency problems in schools?" To find the answer, we conducted a large-scale assessment, looking at the accuracy and the fluency of basic addition facts in both special education and regular education students in

Nashville, Tennessee. We looked at students ranging in age from seven through fourteen, and the results were really quite interesting. What this first slide shows is the accuracy of response for regular and resource room students, ages seven through fourteen. We matched these students on age, sex, and race. One group was served in special education classes, the other in regular classes.

What you notice from this, or what struck us, was that at age seven and eight, the resource room students are far less accurate than their regular education peers. However, by age nine, they almost catch up with them in accuracy. And they continue, at least up to age fourteen. This was encouraging to us. From these data, it appears that at ages seven and eight, students are trying to develop those counting algorithms you saw students exhibiting in the previous video tapes. Discrepancies did appear, however, when we looked at fluency. As you see in this slide, at age seven there is a small discrepancy; as the students get older, that discrepancy gets larger. The tasks require these students to recall number facts within three-quarters of a second, so we know that they are not counting on their fingers in these cases.

You can see that by age fourteen there is quite a difference between the regular and special education students. What this shows us is that once these special education students start counting on their fingers, they don't give it up. You can see that by age fourteen these students only had forty basic addition facts. If you consider minimum addins of zeros, ones, and twos—three plus one, eight plus two, etc., that accounts for more than fifty percent of the addition facts. At age fourteen these kids are not even recalling fluently addition facts much over minimum addends of three. This really quite a disturbing problem, and we decided there must be some way to remedy it. And this was only basic addition and subtraction—we haven't even looked at multiplication and division. With problems this severe, we asked ourselves, how are these special education students ever going to do higher level skills?

We set out to help these students develop fluency in basic facts. That's where our next study came in. Conventional wisdom told us that if we used computer-based drill and practice with these kids, and used it enough, they would give up those counting strategies and start recalling this information from memory. They would become fluent; their problems would go away. So we went into a classroom and provided a commercial version of a drill-and-practice program for every student. Every student was on the computer daily for five to ten minutes. We looked at their fluency before our intervention and after, and the results were quite interesting.

What we found was that using the drill and practice program even as many as seventy intervention days, which is a very large number of intervention days, had virtually no effect on the development of fluency. Students who came in counting on their fingers, left counting on their fingers. We did make them faster at counting on their fingers. And they became more fluent in the simple math facts they were already recalling from memory, such as adding doubles—eight plus eight, five plus five—or small addends like zeros and ones. If they were already doing this, without relying on counting strategies, the drill and practice was really quite effective. It would drop their response latency to somewhere under half a second, making them very fluent. If they were relying on a counting strategy, the drill and practice had no effect whatsoever.

We were pretty disillusioned by these results. But, we were not defeated. We decided that the computer technology was really ideal. What we needed to do was change the task somewhat so that, first of all, the students were retrieving information from memory. Once they were doing that, then we could put them on the computer using traditional drill and practice and make them more fluent. To do this we developed a set of software designed for retrieval training. I'm going to now go through a number of design principles that we considered.

We looked at the cognitive literature to reexamine everything we knew about learning. We also looked at effective teaching literature and tried to excerpt from there anything we thought we could build into this software that would make a difference with these kids. The first thing we wanted to do was an assessment on those students. We knew from our original drill-and-practice study that we needed to treat facts that they were retrieving from memory very differently from facts that they were using counting strategies to solve. What you see here is a simple assessment task we set up to separate out these facts. It's nothing more than seeing a fact and typing in answer correctly. What we're doing here, though, is looking at more than just the accuracy response. We're looking at the latency of response. If they respond under .75 of a second, we consider it a retrieved fact. We put that fact in a drill-and-practice program that will simply help the students recall it faster. If they are answering over .75 of a second, we assume that some counting could be going on. We don't want to give them drill and practice on that because we know that the only thing we're going to do is strengthen their counting on that fact.

So, first of all, we make an assessment and separate out retrieved facts from nonretrieved facts. The second thing that we do is provide a very small practice set. The problem with most drill-and-practice programs that we've looked at is that the practice sets are in most cases very large. In many cases they include the entire set of addition or subtraction facts. What we want to do is give the student one fact at a time to learn. We also want to emphasize pairing, associating the answers of the problem with the problem itself. Most drill-and-practice programs do not do that. Instead they give the student a problem, which the student simply answers by counting, but does not, for some reason, try to remember the answer to that problem or automatically associate the answer with the problem.

We start out a little differently. We require that the students first tell us what the problem is and then what the answer is. They have to type in the problem that they're working on and then the correct answer. Once they can do that, then we go ahead into the actual program. The third part, which we think is extremely important, is something called controlled-response time. Again, very few drill and practice programs put any limit on the amount of response time. Unlimited time allows students to fall back on their counting strategies. What we do is set up a response time of 1.25 seconds. If they cannot answer within that time, which you'll see here, we give them a prompt.

(SLIDE IS SHOWN.)

There's our target fact. At 1.25 seconds, the icon tells the students that they did not miss the problem, but that they did not answer it quickly enough. We go ahead with modeling, and they have to type in the correct answer themselves. As long as the students respond within that 1.25 seconds, they're okay; that is the controlled response time.

Another design feature of the software is called "spaced retrieval." Here the target fact is interspersed with facts that the students already know. We don't want to cause interference. We simply want to alternate between facts the students already know and the target facts they are learning. Gradually, we expand the time students have to remember the target fact, as you will see in these slides.

First the student sees the target fact. Then he sees a fact that he already knows. Then the target fact again. Before the target fact is presented again, he will be asked presented with two facts that he already knows. This spaced retrieval would continue until ten known facts were inserted between each target fact, requiring students to remember the target fact for longer and longer periods. The research that we just completed suggests that this is a very, very important part of our program, much more important than we actually thought in the first place. Finally, once a student is able to recall the target fact ten consecutive times without an error, using that expanding procedure, we say it is a learned fact, one the student can retrieve from memory. The fact then goes into the set of known facts that we include in straight drill and practice.

Here is an example of one such drill and practice program, one designed as an arcade game. The students simply supply the correct answers to keep the balloons aloft. It's a very simple program, but very appropriate because all we are trying to do is force students to recall the information as quickly as they can. They are only practicing facts that they are able to recall from memory. If they cannot recall a fact from memory, they never see it in the drill and practice. We also believe that the more opportunities students have to respond, the better off they are. We try to pack as much in as we can. The literature on academic learning time and opportunities to respond suggests that students need several opportunities to respond in a relatively short period of time.

I'm going to show you another drill and practice program that's currently on the market and you'll see that the student has fewer chances to practice each problem because the computer graphics and so-called reinforcement actually interfere with the opportunities to respond. Watch what happens here: A student gives the correct response, then sits and waits for another chance. Here the software program designed for practice actually reduces the student's opportunities to respond. Look at a student on another kind of software and you'll see the difference in the number of opportunities he has in the same period of time. You can see that this program provides far more opportunities for the student to practice the skills.

Another component that is built into our program is management for both the student and the teacher. We think that management is very, very important. A lot of drill and practice programs assume that every time the student sits down, he is doing so for the first time. We do a great deal of record keeping and also provide the student with feedback at the end of each game. At the end of the Fast Facts game, students get some information on how they did; we also keep a record of all the addition facts that they are working on and where they are in learning that set of facts. In the example you see on the slide, the students see the facts they have just learned, those that will go into their drill-and-practice file. The students are updated constantly on how they are doing.

Finally, and probably most importantly, the program has to be easy to use; it cannot take away any teacher time. Otherwise, teachers are simply not going to use it. Here's an example of a special ed class in Nashville. The teacher just took these kids down to the computer lab to work on the math program. The program is individualized for each student. Here, after forty or fifty days into the study, the students are still highly engaged by the activity. It is almost effortless for the classroom teacher. She is able to take her entire class from the resource room down to the lab and get them back in about twenty minutes. As she told us, it was really no problem at all.

That's all well and good, but what effect does all this have on students? We've been conducting large-scale evaluation of this fluency software over this year. We set it up in three groups. We had a control or contrast group of resource room students who received nothing from us. No computer training. They received only their regular classroom instruction. Our second group was regular ed students who were matched for age, sex, and race with our control group and our experimental special ed students. They also received no instruction beyond that in their own classroom. Our experimental group received, on a daily basis, or as often as they were in school, instruction using the software that you just saw. It took them five to seven minutes every day to go through that software set.

In this first slide you'll see that after about forty days, our control group, with no extra instruction, made virtually no gains pretest to posttest. These students did not increase the number of math facts they were retrieving from memory over that period of time. The next slide shows that our regular ed students, as we predicted, picked up about eight math facts in the six months between pretest and posttest. The nice parallel growth is what we expected. The experimental students who received the software training really did much better than we expected, picking up more facts actually than the regular ed students. If you look at the absolute growth over the three groups, you see that the resource room students, represented by the top line with the squares, picked up almost twenty-four new facts. We used an extremely stringent criterion for automatic recall; we required that students recall facts within .75 seconds, two consecutive times, without an error during our posttest. The resource room students, therefore, did quite well. So you can see, by comparison, the regular ed students picked up about eight facts and the control students were virtually unchanged.

One thing we were concerned about was what happened when the counting strategies were taken away from those kids. Would it affect their accuracy? The next slide shows that it actually improved their accuracy. Our seven and eight-year-olds closed the discrepancy. They became more accurate than before. Our other students improved just slightly, one or two percentage points, over their pretest scores. Thus, helping students give up their counting strategies had no detrimental effect upon their accuracy. Students were either as accurate or somewhat more accurate after the training.

In summary, we've concluded from our study that fluency, whether it is fluency in mathematics, reading, spelling, or whatever, is an extremely important skill, and that technology can be used to help handicapped students develop that skill to a level equal to that of their nonhandicapped peers. We had only about forty intervention days with these students. Had we worked with them for an entire year, they would, we believe, have caught up to their nonhandicapped peers, given the rate of growth they experienced. Next year we will be able to look at that more carefully. The principles that we've discussed here, I think, point out something that is very nice: And that is, that as they learn, these kids often change their attitudes. They feel better about themselves. They feel better about mathematics.

(VIDEO BEING SHOWN.)

This is David, whom you saw before. Just look at the difference in his body language, if nothing else, during his pretest and posttest. This is his pretest again. He's pretty frustrated. And this is about forty intervention days later. (CLIP FROM VIDEOTAPE.) David is no different from most of the kids that go through the training. They gain a great deal of self-confidence. Teachers tell us that it changes their attitudes towards mathematics, and we get some very, very positive gains from that. I think that if we could leave you with any message, it's that the existing technology in the schools will work, if it is used effectively. We have to look very carefully at how we are using that technology. We have to draw upon the cognitive and effective teaching literatures. The problems that these students are having are not easy to overcome, but they are not insurmountable. I think that if we apply technology in the ways we have looked at in our studies, there are going to be some impressive gains. Thank you.

John Bransford

I think this study provides an excellent example of the importance of fluency and the importance of detailed software design. We are going to continue to emphasize the importance of fluency throughout this presentation, but we also want to illustrate some additional ways that technology can be used to enhance academic achievement. For this part of the presentation, we're going to focus on the use of microcomputer and video technology to create semantically rich contexts for problem solving and discovery. This contextualized approach to instruction has a number of advantages over traditional approaches, which tend to be decontextualized.

Let me try to explain this point in a little more detail. Imagine that we want to find cases where learning for almost all people is spectacular. The learning that occurs during the first five years of children's lives seems to qualify. Children learn language, concepts, social skills, physical skills, knowledge of their spatial environment, and so forth. The amount they learn is remarkable. We want to emphasize that children learn the knowledge and skills appropriate to their particular culture or subculture. Researchers such as Shirley Brice Heath (1983)[1] show that the skills emphasized in some subcultures do not necessarily match the ones presupposed by our existing school systems. Therefore, not all children are equally prepared for school. Nevertheless, if you look at what is appropriate for their culture, the amount they learn is truly remarkable.

Researchers have begun to analyze some of the conditions that make children's early learning so successful. One major advantage seems to be learning in the context of meaningful, ongoing activities. Imagine a decontextualized approach to language acquisition in which we could for one hour a day take a young child into a room and randomly introduce some new words and have him memorize the definitions. A child does not learn language that way. A child learns language by making sense of his or her environment. Research also suggests that children learn best when they and a parent or some other mentor share a context that can be mutually explored. This idea of a shared context really isn't new; preschool educators have known it for years. When, for example, we talked to Susan Gray about her early training project, it was clear that she really loved to take children to environments that were meaningful for learning. One of her favorites was the grocery store.

Dr. Susan Gray (on video)

I remember that we would take them to the grocery store, because that is one of the most wonderful places in the world to teach children classification.

John Bransford

She is talking about letting children see the relevance of categorizing food in various ways. They can also be helped to appreciate other aspects of a grocery store, like the advantage of having signs that tell people where to look. It is often not possible to take groups of children to the grocery store or to the airport or to the beach. People therefore use a lot of other strategies to help children understand. As parents, we often rely on experiences that we have already shared with the child. If, for example, a neighbor comes over and talks about large sailing ships on the sea, we might remind the child of another ship he has seen with us or read about.

Parents naturally help children relate the past to the present in order to help them understand new things. These strategies work well as long as we know the experiences of our particular child. But, what happens when some children are lacking in their experiences, or when we as teachers do not know what experiences are relevant for a particular child? We often cannot share a context with children and help them understand something because we do not know what they know. And here's where technology such as videotape and especially videodisc becomes especially valuable. With them we can create contexts that teachers, children, and, ultimately, parents can share. We're not going to have children just watch movies; we're going to create contexts on which we can build.

I want to illustrate the potential power of videodisc technology for preschool programs by a study conducted in Nashville by Rich Johnson (1986),[2] who just completed his doctorate in early childhood education. There are really two studies I want to talk about. Rich worked with inner-city children, four- and five-year olds, in a special program in Nashville to try to give them a head start in school. After the students had been in this program for about three months, Rich looked at two different assessments of their progress. First, the teachers' assessments of whether these children were ready to go on in the regular school system or were definitely at risk; and, second, formal assessments like the Peabody Picture Vocabulary Test. From the same population, Rich selected students who seemed to be at risk and students who did not. He provided both groups with stories of information about various events, and then asked them to retell the story. Let me just show you an example of a child retelling the story of the *Swiss Family Robinson.*

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[1] Heath, S.B. (1983). *Ways with Words: Language, Life, and Work in Communities and Classrooms.* Cambridge: Cambridge University Press.

[2] Johnson, R. (1986). Videodiscs and story comprehension. Unpublished manuscript. Nashville, TN: Vanderbilt University.

Child (on video)

And then the next morning they got up, and they got into the water and started swimming and got in the boat, and then they started and they saw a turtle.

John Bransford

Johnson provided the children with a simplified version of the first part of *Swiss Family Robinson.* This story makes a nice problem-solving context. There's a shipwreck, they have to get to shore. Rich had students retell the story as the student did here, and then he asked them comprehensive questions. Look at the data here and compare the retelling scores of the students that teachers had said were at risk to the scores of those who teachers said were not. There are huge differences between those two populations on this task, and also on comprehension scores. Whatever the teachers are picking up is really shown dramatically in this task.

The retelling test requires several different language abilities. So Rich asked himself how he could work with just the at-risk students to develop the language skills, the knowledge of story events and the knowledge of retelling that they would need to prepare for activities like reading. He wanted to teach the first group pre-reading skills the way they are typically taught, which is verbally.

Language is an absolutely wonderful tool, but what we know from studies of language is that language comprehenders have to use their knowledge to fill in all kinds of gaps in messages. In fact, if we don't have the relevant knowledge, language doesn't work so well.

For example, if I say, "The haystack was important because the cloth ripped," you probably have trouble understanding me. If I say, "We're talking about parachutes. The haystack was important because the cloth ripped," you could probably get a click of comprehension. You would have inferred that the parachute was probably above the haystack; that I fell into the haystack. Based on your knowledge, you would have made all kinds of assumptions. We're usually not conscious of them, but we make assumptions like these all the time.

So, language is wonderful when we have the knowledge or when we're talking about something in our immediate context. It's not as powerful when people do not share the knowledge that's presupposed. Rich decided to tell one group a simplified version of this first twelve minutes of the *Swiss Family Robinson* story and to show the other group a videodisc of the same part of the story. The data I want to show you initially shows the retelling scores of children who just hear the story. You can compare their scores to those of the four-year-olds and five-year-olds who saw the video version and thus had visual as well as verbal information. You can see that there are extremely large differences. The bar on the right shows that the four-year-olds who saw the video could retell the story much better than those who only heard the story. You see exactly the same pattern for five-year-olds. In fact, the smallest difference here in percentage of retelling scores is 100%. You see similar results on the tests of comprehension. So, being able to see things, as well as hear language about them, has a great effect on children's ability to retell. It gives them a lot of practice at being able to use language to describe events.

Rich Johnson wanted to do something else. He also wanted to work with the children to teach them what it really means to understand a story. If children do not know what it is to fully grasp a story's meaning, they don't know when they have adequately comprehended a story and when they haven't. Again, Rick wanted to compare the results of working with children in a purely verbal mode to the results of using a videodisc and the rapid access it provides. If, after the child has heard the *Swiss Family Robinson* story, you say, "Do you remember when the ship hit the rocks?" and the child says "No," you don't have many options. The child can't go back and read the text. You are forced to simply say, "Well, the ship did hit the rocks." Even if the child says, "Yeah, I remember," you're not really sure if the child remembers the scene accurately or not.

Contrast this situation with one where you say, "Do you remember when the ship hit the rocks?" and then, with a videodisc, you can go back very quickly and find the right segment. You could have the child tell you whether that one was the right segment, you can talk about it with him, you can look at the detail, like the crashing sound, that helps us infer that the ship hit the rock. Videodiscs have the great advantage of allowing you to go back instantly and find almost any piece of video that you want to use for teaching.

In his study, Johnson taught story comprehension using *Swiss Family Robinson*, and both the all-verbal group and the videodisc group learned a great deal from the instruction, their retellings improved and their comprehension question results improved. However, the videodisc group learned far more. In fact, the posttest retelling scores for the verbal group never reached the pretest level of retelling scores for the visual group. The addition of a visual context gave them a great advantage.

Now, let me make several points. First of all, we know that video technology sometimes can promote passive viewing and passive learning. But it doesn't have to, especially with the videodisc. With it you are not limited to showing an entire story; you can get students actively involved in specific events of the story. Here are some students who are recognizing an animal.

Student (on video)

A zebra!

John Bransford

They're very actively involved. Let me show you the next one, where they recognize a skunk.

Student (on video)

Yecch! What a rotten smell. I'm going to hold my nose.

John Bransford

These students are anything but passive observers. The more important point I want to emphasize is that we don't want to make children dependent on video. We want to build on it, not build dependencies on it. And, you can do that in certain ways. One thing we want to be able to do is help them experience the difference between understanding something well and understanding it poorly. And they really must experience those differences to begin to get a sense of what it means to comprehend. We can also use the video as a source of analogy for understanding other stories. For example, as students learn about *Swiss Family Robinson* and the problem-solving that goes on there, they can use that knowledge as a source for understanding purely verbal stories about someone who is going on a trip somewhere else.

We can also use video to illustrate the importance of literacy. Our colleagues in early childhood education at Peabody are trying to help us focus on ways to help children see the advantages of books and other reading materials. Again, the goal is never to replace reading activities with video, but to build on them. And when that happens, we can start to share a context with a child; we can then know what they know, and what we can use to help them understand new things; we can, in essence set the stage for reading.

Let me quickly mention several other things about videodisc technology. First, a lot of people think it is extremely expensive, far too expensive for preschools. It is, however, much less expensive than many people think, if we think simple. For $425 (which isn't much more than a videotape player) you can get the new videodisc players that are really excellent, and you can run them with hand-held remote controls—almost like a television. You can put in frame numbers, and as long as you know what those frame numbers stand for, you can go back and find any segment of video that you might want to use to teach. You can also edit.

Susan Williams created a very elegant menu-based computer program that eventually should be able to run on almost any simple computer. In fact, that's what we're using in this presentation today. By just watching the presentation you really cannot see the advantage of videodisc over videotape; but, if you had seen us go through our preparation to give this talk last Friday you would see it clearly. Our practice talk was much too long. Had we had our presentation on linear tape we would have been stuck with it. But with disc technology we could edit video just like we edit tape in word processing. It really is a powerful tool.

Second, there are hundreds of movies and other sources of video now available on videodisc. They are less expensive than tape and they are more durable. They cost about $35 instead of $60. There are numerous sources of video out there. Third, and equally important, it's legal to use any commercial video or movie as long as you buy it as a school and do not rent it, and as long as you use it for education and not just for entertainment. There's a good article by Becker in *Electronic Education* (Nov./Dec. 1985)[3] that discusses these legal questions.

We also want to emphasize that contextualized learning is not simply for children. It is also excellent for middle school students and can even be helpful for college students. A good example is the *Voyage of the Mimi*, in which they created a story of whaling and then developed software around it. The only drawback to this excellent example of contextualized learning is that it is very expensive to produce such a video. One of the things that we have done is to take existing movies or segments of them and use them as prototypes to try to test the effectiveness of contextualized learning with older students.

Let me give you an example in which we used the first twelve minutes of *Raiders of the Lost Ark*. Just to remind you, in *Raiders of the Lost Ark*, Indiana Jones goes to the South American jungle, where he really has to do a lot of things. To children it initially looks like pure adventure, but it really involves a great deal of problem-solving. For example, you can help students realize there's a lot of evidence in that first twelve minutes that Indiana Jones planned ahead: he took maps with him, he knew to put sand into the bag before he got to the idol. You can help students discover the evidence for themselves. You can also ask them to suppose that they wanted to return to that jungle. There's some information it would really be helpful for us to know. For example, we would need to know if the plane is too big to turn around in the river. We would also need to know if we could jump a pit as wide as the one Indiana has to jump at one point. It would help to be able to measure things, but of course it doesn't do any good to measure things on the screen. What you can do is introduce the idea of relative measurement. The students might take Indiana Jones as their standard. Assuming that he is about six feet tall, they could figure out that his pit is about twelve feet tall, because it is two Indianas wide. They could then figure out whether they could standing broad jump twelve feet or not.

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[3] Becker, G. (1985). A question of copyright. *Electronic Education* Nov./Dec., 19

We can also use a graphic overlay to estimate a measurement, as is used here with the pontoon. You can see that Indiana has been swimming up to the pontoon and you can, with graphics overlay, find out that the pontoon is about three Indianas long—about eighteen feet. I want to emphasize that the graphics overlay that Laura and Susan programmed for us is nice to use, but you really don't need it. Here is Stan, one of our graduate students, using the time-honored method of just pointing to the screen and using his fingers. It works very well.

Right here he's talking about Indiana Jones' vine problem and trying to figure out how long that vine really is.

We've conducted some studies with math-delayed fifth and sixth graders who are one and one-half years behind their peers in school. We contrasted typical approaches to learning to solve word problems with an approach that first set the problem-solving context, as we just did in trying to determine the width of the pit by seeing how many Indiana Joneses wide it would be. We emphasized the qualitative or visual aspects of the problem first and then added numbers. The more typical strategy for math-delayed children is to just pull out the numbers and do something with them—add, subtract, whatever. We tried to give the children a qualitative sense of the nature of the problem. We've had very, very positive results with these studies.

First, we gave two different kinds of pretests to two randomly assigned groups. One pretest included only word problems that had nothing to do with Indiana Jones and, as you can see, students scored terribly on them (left of the graph). On pretest two we gave problems that referred to the Indiana Jones context, and found, as we expected, that it doesn't do any good just to refer to that context; we had to teach in that context. So we had one group we taught in the context of the movie. The other group we taught one-on-one, giving them feedback, but we taught out of context. Finally, we gave posttests to both groups. Posttests included some problems that had to do with Indiana Jones (contextualized) and some that didn't (decontextualized). (Part of the instruction each day helped the videodisc group move from in-context to out-of-context.) We found that the videodisc group did very well on the posttest. The second group performed about as well as they did in class; they didn't show much progress at all.

Let me illustrate a second point with representation scores. We found that the quality of visual representation was much better for the kids who were taught in context than for those taught out of context, in part, we think, because a context enabled them to better understand the nature of the problems they were trying to solve.

Our favorite data is informal rather than formal. For example, we brought a number of our summer students to Vanderbilt. While walking across the campus with them, as we often did after working on the math problems, we would find that they would start spontaneously measuring things, like buildings and trees, using themselves as standards. Helping them see the value of mathematical thinking for their everyday activities is really what we want to achieve. That's different from just giving a word problem to students and having them solve it. So, we think that this contextualized approach to teaching can really help them see the relevance of mathematical thinking for their everyday lives.

Bob Sherwood, Charles Kinser, and their colleagues (1987)[4] have used a similar approach to teach science. We ran the initial studies with college students, giving them a number of passages that frequently are given in science classes. For example, they might be asked to read and learn facts about water and water purifiers. So you might read facts about water and water purifiers. Or, they might be asked to read about the density of metals, like gold and lead, which students do not particularly like to read about, or about bronze-age lamps and how to make them.

One group of students just read passages, as they are typically asked to do. The other group was provided with a context; they were asked to solve problems that someone like Indiana Jones would have to face. We asked them, for instance, to think about the earlier scene about water, and to remember that they were going to need drinking water, but probably would not want to drink out of that lake unless they had a water purifier. Thinking about water purifiers became significant. We also suggested that they might want to take water instead but that they should remember how much water weighs—a pint is a pound the world around—and figure out how much they would need to carry. These facts take on significance when they are read as a means of solving an interesting problem.

Similarly, we gave the students a golden idol problem. In the movie, Indiana Jones tries to replace the golden idol with a bag of sand. We asked students to estimate how heavy the idol would be if it were solid gold. By the way, many people at Peabody, including myself, assumed that a solid lead idol would weigh about twice as much as a solid gold idol. As it turns out, that's totally wrong. Facts about density, which the students now read to solve this problem indicate that gold is extremely dense. A gold idol would weigh twice as much as a solid lead idol. Students were able to estimate that a solid gold item would weigh at least sixty pounds and a bag of sand about four pounds. Again, their reading took on a significance beyond the text itself.

Let me show you quickly the data from the college students' tests. The video group, which was given problems in the context of *Raiders of the Lost Ark*, recalled information better and thus scored higher than the control group, which was given problems out of context. For an even more important test, we put students in new problem-solving situations. We asked them to suppose they were going on a journey and wanted to plan effectively. We asked that they not tell us just general things but tell us explicitly how they would plan. We did not tell them explicitly that this problem-solving task was related to what they had just learned. We wanted to see if they would use that knowledge spontaneously. Here we found even bigger differences between the video group and the non-video group than before. Students from the video group spontaneously said, "Gee, if I'm going to go here, I would really need to figure out not just that I need water, but how much it weighs," and so forth. They used that knowledge; it was not inert knowledge. One of the real advantages of contextualized learning is that it helps students organize their knowledge to solve subsequent problems. Much of the cognitive literature shows that when students just learn facts, they do not access knowledge; it remains what many people call "inert knowledge." It is rarely used.

I might mention that Bob has replicated this study with eighth-grade students who were at risk and having considerable trouble in school, and with fifth-grade students as well. With both groups he had very positive results. We would like to suggest that macrocontexts like these be used to integrate information across curricula. Rather than learning science separately from math and separately from reading—although they must do that to some extent, students would be taught to integrate their knowledge to solve academic problems, as well as real-world problems. By teaching students how to take what they have read in different subject areas and link it together, we can increase their ability to think, to remember, and to draw on their knowledge later on.

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[4] Sherwood, R., C. Kinzer, T. Hasselbring, and J. Bransford (1987). Macro-contexts for learning: Initial findings and issues. *Journal of Applied Cognition* (1), 93-108.

Sherwood, R., C. Kinzer, J. Bransford, and J. Franks (1987). Some benefits of creating macro-contexts for science instruction: Initial findings. *Journal of Research in Science Teaching* (24), 417-435.

Let me now turn to the third aspect that we want to talk about, which has to do with students as producers. So far in our discussion we've tended to focus on students as recipients of our teaching. We've talked about helping them develop fluency in skills such as math and reading. We've talked about helping them acquire integrated knowledge structures. These are all important aspects of instruction, but we can also help students become producers of information instead of just consumers. A lot of people are worried about the consumer emphasis in technology.

Voice on Video

So the audience for commercial television and also public television is a great many people who are merely consumers, which is fine, up to a point.

John Bransford

We think that, with new technologies, we can help students start to be producers of information rather than just consumers. There are many examples that I'm not going to show on video because we really don't have time. But I do want to mention IBM's *Writing to Read* program. Its goal is to help students produce knowledge, and learn to read by writing. Another excellent example is the *Geometric Supposer Series* by Dr. Judith Schwartz and her colleagues at Harvard. With this software students can test the geometric principles they think might apply in certain situations, experimenting with them in ways that would be much more tedious with paper and pencil, and eventually prove or disprove their claims.

A third example that we have done extensive work with is *Logo*, developed by Seymour Papert and his colleagues.[5] *Logo* helps students design interesting creations. We found in our studies in Nashville that students are really proud of creating these products; in addition, we found positive changes in attitudes, both towards technology and towards school. But these changes took two things: one, we had to teach the students problem-solving rather than just let them sit down with *Logo*; and, two, we had to work with them an hour a day, every day for six weeks, to help them develop the fluency in the basic parts of the program. We purposely work with academically lower-achieving students, for whom *Logo* was hard; they were ready to quit within the first week. We got them to stick with it and develop some fluency in the basic components. Then they saw that they could really do some very interesting things.

There is one other aspect of students as producers that we want to talk about briefly, and that is the combination of texts and videodiscs. This combination allows students to create some extremely interesting products. A number of people, including Cindy Char and her colleagues at Bank Street and Don Nix at the Experimental Research Group at IBM, are working on programs combining texts and video, but the example I want to show you here is an easy-to-use producer program we've developed at Vanderbilt. This is a NASA videodisc, and this girl is actually writing a story combining text and video. Let me just show you some of the advantages of using this. The simplest is the audience. Look at the intensity of their enjoyment of these products. It would be very hard for a student giving a book report to keep an audience that interested. Here's a boy demonstrating to his class; you can see he's happy with their responses. Let me show you some girls working on scenes for a project they're doing, and let me also quickly show you the product that these two girls and one other colleague created; it's called The Snake Shop. We, by the way, had no hand in what they decided to do.

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[5] Papert, S. (1980). *Mindstorms*. New York: Basic Books.

(VIDEO BEING SHOWN— STUDENTS READING DURING PROJECT.)

John Bransford

I'll read it, because the text doesn't come out on the screen. "In our snake shop we will let you pick from millions of snakes." (music plays) "You may want a large snake," (music) "or a dancing snake." (music) "We've had many proud customers." (music) "They come with their own box." (music) "Snakes like singing, so always sing to your snake." (music) "We have delivery people who insure the delivery of your snake." (music) And they go on to say, "We know you'll enjoy your snake for years to come: The End." It's amazing when you think that fifth- and sixth-grade students can really hold the attention of their peers and of adults, who then give them feedback.

I'll show you just a couple of other magic moments in working with this. This next one happened spontaneously; the whole class started reading in unison. (shows video of class reading). By giving students appropriate guidance, you can also make these stories much more academic. Here's a case where students were studying different kinds of light in science, and they started to use discs from *Star Wars* to do it in more detail. (shows video). When you set products like these as goals for students and then allow them to read and use database software, word processing, and so forth to create products, you increase motivation and let them generate the ideas This lets them generate products that other people really want to watch. Positive feedback encourages them to make their products even better, and a two-way, self-perpetuating learning process is set in motion.

Let me summarize with some recommendations. We have talked about four aspects of research that we thought were very important. We began with Susan Gray and the importance of creating intrinsic motivation and increasing the transactions between students and teacher. Then, we discussed some of the cognitive literature on fluency; if you remember, our houseboat expert was a good example of a fluent pattern of recognition building. We also talked about Schneider's research, in which, with the right practice, people get extremely good and frequently surprise themselves. Next we talked about Ted and Laura's excellent work on fluency in mathematics, and the importance of the careful design of software to tackle this problem.

We moved from a discussion on fluency to a discussion of developing well-organized knowledge structures. We talked about Rich Johnson's studies with four and five-year-old at-risk students, in which he found that showing stories on videodiscs versus just telling stories produced powerfully different results. In connection with this study we said that contextualized learning is not simply for young children. We described a mathematics study in which we created a meaningful context for learning about mathematical problem solving. We also talked about Sherwood and Kinser's work on teaching science information in the context of solving interesting problems. We talked about the possibility of integrating knowledge across curricula with a contextualized learning approach. And, finally, we talked about the idea of students not simply as consumers of information, but as producers of information. An especially good way to make them producers is to combine texts with videodiscs, allowing students to create products that they're extremely proud of and will do a lot of hard work for. If the task is academically focused, a lot of learning takes place.

We have a few suggestions we would like to see this group consider. First, we'd very much like to see this group develop some public-domain videodiscs that could be used by any software developer, any textbook publisher, or any teacher. The videodiscs wouldn't be lectures plus examples. Instead, they would be designed to serve two important functions: First, they would function as invitations to thinking and discovery, much like the little part of *Raiders*. And, secondly, they would provide support for student-generated productions. The discs would, therefore, look quite different from typical educational films. They would provide a meaningful context for integrating other aspects of technology, like data-based management systems.

Some quick examples: imagine that we really wanted to do a preschool disc that would be useful for preschool teachers. We'd need to talk with a number of them. We could put 54,000 slides on one side of a disc. Why would teachers want a disc player rather than a slide projector? Because they would have instant access. When the need arose it would be much easier to get to slides and use them. For example, if preschool teachers needed short, dynamic scenes—maybe five seconds to show wind, or waves—they could show them far more easily on disc than on slides. Furthermore, we could actually create adventure discs that allow young students to be producers of their own stories. At Vanderbilt, we've developed a prototype disc that kids really seem to enjoy working with. It allows them to choose protagonists for their stories, and perhaps villains; it also allows them to choose a context or setting. Then the teacher can engage them in reasoned decision making to solve certain problems. They really like looking at these; they really like making decisions; and they really like being able to create stories that they can show and tell to their peers. In addition, if the story is on videodisc, it's easy to transfer it to videotape and have the student take it home and share it with parents, who, by just using a pause on a videoplayer, could also engage the child in decision making. For example, you can get the child to give two reasons why he wouldn't take this TV with him to the mountains: there are no plugs there, it's too heavy, and so forth.

Another example of discs that we really would like to see are ones that provide historical anchors for linking science, geography, and so forth. They might involve news clips; they might involve speeches; they might involve engravings. There are numerous possibilities already available on video. For example, in a project we're working on right now, in which students will eventually use our producer program, we have focused on the turn of the century. It turns out that in several movies people have taken a lot of pains to recreate the atmosphere of the turn of the century accurately. In *Young Sherlock Holmes*, the setting is the 1890s in England. Students can look at the video and explore the climate. They might ask themselves, Is this the way it should be? What was Victorian England? Is the setting right? Did they really have carriages then, no cars? There's some little plane that shouldn't be there—we know that's fantasy, but, when did the planes come in? They might wonder what New York City looked like in 1890. As it turns out, in *Hello, Dolly*, they spent a great deal of money to accurately recreate the New York City of the 1890s. The movie *Oklahoma* contains wonderful recreations of Oklahoma in the 1890s. We would like to find out if it would be possible for a group like this to get the cooperation of some of the people in Hollywood who've done such a great job at creating some of these scenes. Could we get permission to use these to press some kind of turn-of-the-century disc, or maybe a World War I disc, a World War II disc—discs that could be used as invitations to thinking. Students, as producers, could track down their accuracy.

Our assumption here is that something like this could be done. On a very general level we urge you to remember, as you think about videodisc technology, that it isn't as expensive as people tend to think it is, if you use it at a simple level. And with videodisc technology the whole notion of linear films changes. What doesn't work linearly, or doesn't work all that well linearly, can become extremely powerful with random access. We should, therefore, take a new look at old existing footage in order to see how we might use it to create the kind of meaningful macro-contexts we've been describing for children to explore.

The second thing we'd really like to see is general software that would support simple uses of videodiscs and computers. Our learning technology center has produced a program that's very simple. We've actually given it to anyone who would like to use it, and students can learn it within about an hour. Menu programs like the one Susan Williams has designed for easily making a menu that allows very flexible editing is extremely helpful. Ideally we would have generic systems that were similar across different kinds of hardware, and it would also be ideal if these could be public domain. Where we see commercial development is in the particular software and particular texts, that provide the knowledge necessary to explore certain aspects of that domain.

Third, we want to reemphasize the importance of fluency that you saw in Ted and Laura's work. It really tends to be under-appreciated. We're not talking about mindless drill and practice. We are talking about helping students and teachers understand very important processes involved in the development of expertise. We all have to go through these bottlenecks, but with the appropriate design of software, we can help students get past them. It really is an exercise in problem solving. They have goals, they have obstacles to achieving those goals, but with our guidance they can do what it takes to overcome them. We do need, however, the kind of design and monitoring you saw in Ted and Laura's program. We need to be able to figure out what strategies students are using. With off-the-shelf hardware it's possible to do that; most software right now doesn't do that, but still it is possible.

Finally, we would like to have materials and strategies that would help teachers learn to use existing technology more effectively. Again, one way might be to put segments of actual teaching on videodiscs, because they can be used flexibly. We, at least, find videodiscs much more useful than linear videotapes. If we really started to look at what's out there, and how it might be combined, we would, I think, find that the existing technology really has the potential to do a lot of good. Thank you.

Robert E. Blair
Executive Director, Canadian Education Association

James P. Shea, Manager, Research and Evaluation, Agency for Instructional Technology

The Use of Technology with Students at Risk

Robert Blair

When AIT asked CEA to conduct the Canadian part of a North American survey on the innovative uses of technology for students at risk of school failure, we first looked at our vertical files. We found lots of programs for dropouts and potential dropouts, but next to nothing indicating any special use of technology. We then sent an open-ended questionnaire to 114 Canadian school systems representing about one-third of the Canadian student, elementary, and secondary population. The survey included large and small urban schools and large and small rural schools.

The survey results were pretty much as expected. We found there were a few interesting things happening in a few places. By far, the majority of Canadian school systems are not making much use of technology to help students at risk of school failure. That, to me, points out the need for this conference. If technology is in fact helping some students at risk, then obviously it can help a great many more. So congratulations to Ed Cohen and all the folks at AIT for recognizing a need and doing something about it.

Jim Shea

Thanks, Bob. It's a pleasure to have the opportunity to address such a distinguished group, even if it's only for three minutes. As Bob indicated, the survey that we sent out was very much open-ended because, frankly, we had very little idea of what to expect. To analyze the results we had to wade through a considerable amount of prose. Described in that prose were 360 programs representing quite a diversity. We produced a couple of documents that describe those returns. A summary, consisting largely of descriptive statistics, was sent to you in advance of this conference. We now have an expanded version that is in your three-ring binder titled *A Survey of the Use of Technology with Students at Risk of School Failure*. This version contains more information about the background of the survey and the sampling techniques that we used in sending it out to the schools. It also contains profiles of many of the programs that were described by the respondents. These profiles include a description of the program and the name and address of contact person for that program.

It is our hope that this document will be a useful resource for you after this conference. However, we didn't feel that it was a wise use of your valuable conference time to examine the findings in detail. Instead, what we would like to do is give you more of an in-depth look at what's happening in three of the sites that were described. To do that we have produced a slide tape. It was very difficult to select three programs out of the 360 that were described, so we established two criteria for selection. First of all, we wanted to show programs that addressed a wide range of at-risk students. Secondly, we wanted to show some programs that used a variety of technologies. Fortunately, the three programs that we selected were able to meet those criteria. The presentation that you are going to see was a two projector slide program with a dissolve; but, much to my dismay, we discovered last night that the dissolve was not working. So what you are about to see is a videotaped version of a slide program. If we can turn down the lights we're ready to get started.

Slide/Tape Presentation:—Students at Risk: Technology at Work

Throughout the United States and Canada growing numbers of children are at risk of school failure. Their conditions of risk vary, but we can describe them, according to a recent Wisconsin study, as children who are traditionally more difficult to instruct than their peers. Complicated social and economic forces may cause their problems, but the problems tend to have a single result: lowered expectations for these children which compounds their likelihood of failing in school. Computers and television, because they are patient, encouraging, impartial and fun to use, are helping students at risk across North America.

Dr. Arvid Nelson of Indian Springs School District explains, "For years teachers have been in competition with TV. Now we're making that competition into a partnership." The partnership can be seen working effectively in three very different school systems, in three very different places. Indian Springs, a small school system outside Chicago; Escambia County Florida, which includes the city of Pensacola; and, Mississauga, Ontario, a semi-urban area close to Toronto.

Who are the students at risk in the Indian Springs school district? Of the 2,300 students in its five elementary schools, up to 25% may be at risk, for several reasons. Indian Springs is classified as a mid- to low-income community and its population is highly transient. Between 1983 and 1986, 38% of its new enrollments came from the city of Chicago. All of these factors predict low achievement for these children. But in Indian Springs that prediction is wrong. Dr. Arvid Nelson, superintendent, credits the excellent support services which the system provides. But he also believes that the power of technology which saturates this district is crucial to the success of its schools. Geri Orth, supervisor of computer assisted instruction, explains, "We're working from a model which includes CAI, or Computer-Assisted Instruction; and CMI, or Computer Management of Instruction."

Attendance books disappeared from the Indian Springs school system four years ago. Now each teacher has a microcomputer connected by a dedicated teleline to the central computer. This allows them to accept electronic mail, to record attendance, to view the district calendar, to call up the students' cumulative records or any other general identifying information— even a parent's telephone number at work.

The computer also acts as a powerful diagnostic tool which tracks students' progress in reading. Chris Zurawski, Reading Coordinator for Indian Springs, reports that twice a year parents receive a word-processed letter that outlines reading goals for their children and records whether or not the children have reached those goals. Supplementary materials are provided with each diagnosis so that students having difficulty are given a new set of resources designed to help them overcome those problems.

There are 130 computers in the Indian Springs system, one in each classroom, and there are three categories of computer-based instruction which reach all of its students. First, the IBM *Writing to Read* program, which allows children in kindergarten and first grade to spend up to an hour each day in the *Writing to Read* labs where they listen to tapes, learn to recognize and imitate sounds, and then transform those sounds into stories on computers. Second, there is general computer-assisted instruction for children in all grades. And finally, *Grolier's Electronic Encyclopedia*, a software package that contains all the information in a twenty-volume encyclopedia.

Virtually everyone in the Indian Springs system uses computers. How much does it cost? Since 1979 the system has spent $850,000 for its computer installation. We all need to realize that technology is expensive, Dr. Nelson says. School districts should develop plans to pay for hardware and software through long-term, low-interest loans. And they need to forge new funding partnerships with government and private industry to meet the costs. Indian Springs has entered into cooperative funding arrangements with the U.S. Department of Education, the Illinois State Board of Education, and IBM. Indian Springs has found the money it needed and many of the software packages it wanted. According to Geri Orth, "We're lucky to have eight resource teachers involved in selecting and evaluating software, using the results of a needs-of-students survey in which all our teachers participated." She adds, "The machines are fascinating to kids. They love the movement. The graphics are wonderful. They get immediate feedback. We all know that teachers want to provide that kind of encouragement, too, but they don't always have time to recognize each individual success." Time is is what the computer does have. It isn't subject to interruptions, and that may be why technology is so successful in Indian Springs.

System-wide, students scored two to three months above the norm on the California E Achievement Test. This is a striking result given the factors of risk that affect students here. But Dr. Nelson says, "It's only a beginning. Personally, I think our children can learn much more than they are learning in public school classrooms today if we use the technology right."

Using the technology right and finding ways to pay for it, those are the key questions in Escambia County, Florida, where 30% of high school students drop out of school before graduation. The school district serves 44,000 children in Pensacola and around Escambia County. Low income level and low achievement level are two of the most devastating risk factors for students in the district. And if they do drop out of school, their prospects are bleak. Superintendent Michael Holloway reports that 98% of the inmates in the Escambia County jail are high school dropouts. Dropouts often either go on welfare or they go to prison. It was this stark fact that persuaded Escambia County to set up a dropout prevention program.

John DeWitt, Director of Grants and Research for the school system explains the background of the Computer Assisted Remediation Program which the county has established: "Two years ago, the district recognized the problem of dropouts and, working with the job training program of the Private Industry Council, we discovered that the unemployed cannot read or do math. Since so many of the unemployed are dropouts, we decided to develop a computer-assisted instruction program that would teach basic math and reading skills, and keep kids from leaving school before graduation."

There are three remarkable things about Escambia County's dropout prevention program: its innovative funding through a performance-based contract with a Private Industry Council and through grants from the Florida Department of Education; its delivery system—a Motorola 600 Microhost with a hard disc drive connected by dedicated telelines to 88 Hatari SL terminals in eleven schools; and, the phenomenal results of the Computer Curriculum Corporation Software. Jim Boggs, Executive Director of the Private Industry Council, sees the innovative performance-based contract that PIC has with the school system as a sensible arrangement: "We think that the purpose of the Job Training Partnership Act is for us to operate as an administrative overseer. We just pay for the outcome; it's up to the school districts to spend the money as they like."

Paying for the outcome. If a student makes a 1.5 year improvement in either reading or math, the private industry council pays the school system $348. "So far, we've earned $83,000 in reimbursements," John DeWitt reports. Although the $350,000 cost of the system has been met through funding for the remedial program, over 1400 students, including the handicapped, the bilingual, and the gifted, are using the system. And they're using it eagerly because it's fun. Since the basic-skill students get only twenty minutes a day on the computer, and since they want that computer time, they come to school.

It's particularly important for students at risk to have a chance to change, that's what the program gives them—the opportunity to start feeling good about themselves. "I like getting the problems right," says one participant, "and I like what the computer says when I do. It says, 'good,' 'great,' 'excellent.' " For students who have fallen so far behind grade level that they don't hear those words in the regular classroom, it's a wonderful new experience. This program encourages students to stay in school long enough to learn the basic skills of reading and math. And they are staying. Only two of the 350 students in the program have dropped out of school, compared with a 30% dropout rate system wide. They're making progress at the average rate of one month for every hour on the computer. The basic skills they're learning will help guarantee them independence, self respect and jobs after they have graduated. That's the outcome Jim Boggs talks about.

John Frazier, Director of Education for the Peel Board of Education in Ontario, also looks at outcomes. The district accommodates 83,000 children in an area of 800 square miles. How many of the students served by the Peel Board of Education leave school early? John Frazier responds, "Of 100 students coming into grade nine, approximately 30 will go on to post-secondary education. Seventy of those youngsters will leave our school system, with or without a diploma, and go directly on to the job market. So, relevancy to their future needs is something that we've endeavored to stress."

The SALEP Life Skills Program—the acronym stands for Supervised Alternative Learning for Excused Pupils—is certainly relevant to the needs of many students at risk, but this pilot program operates after the student has dropped out of school. Cecil Patriquin, SALEP teacher, discusses the goals of the program. We want to get our students working full-time and we want to encourage them to think about returning to school. Even if it's not going to happen next September, we want to make sure that we don't close the door. Since the students SALEP serves are relatively young—all are under sixteen and most leave ninth grade with no high school credits—there is real hope that some of them will re-enroll. In fact, Lise Skiday, social worker for the program, is helping several of this year's school dropouts to choose their courses for next year. "Sometimes all they need is to work for a while until they realize that 'Hey, working at a doughnut shop is not that great,'" Skiday says.

Funding for the SALEP Life Skills Program pilot comes from the Provincial Board of Education and the local school board, each of which has contributed $200,000 to run the program for the next four years. How does the program operate? For three hours a day, twenty school days in a row, groups of ten to twelve students meet with Patriquin and Skiday in a temporary classroom set up next to a high school. But this isn't school. Even though many of the students are learning-disabled, there is no math or reading remediation. Instead, Patriquin teaches decision-making processes, job-search skills and interviewing techniques. He uses video programming like AIT's ***On the Level*** to examine decision making, and students use software to examine career choices and compose resumes using a word processor.

Patriquin and Skiday get to know their students very well, but sometimes they encounter resistance. "A few of the kids don't like to communicate with us at first, but they'll answer questions on the computer; and, once the answers are down on paper, they'll discuss them quite readily." Once the students are interested, SALEP's most important work is already done.

Like the kindergarteners in Indian Springs, and the high school students in Pensacola, these students feel the draw of the technology first, and then taste its principal reward—increased self-esteem. It is too early to judge the long term effects of SALEP, but it has had these visible results: attendance is good; the students are enthusiastic; and, several of them have found full-time work. In some ways SALEP is the most intense of the technology based programs we looked at. It is certainly the most intimate, and that seems entirely appropriate for these students' needs.

With its early introduction of computers into the classroom, Indian Springs has adopted, in effect, a long-range strategy to reclassify its students at risk. In Escambia County, the intervention has an immediate short-term goal—to keep youngsters in school despite the factors of risk that make them likely to drop out. In Ontario, those factors of risk have already taken the students enrolled in SALEP out of the regular classrooms, so Patriquin and Skiday must match their first goal for their students, finding them full-time jobs, with their second goal, motivating them to return to school.

What connects these three very different programs? Three things: 1) they all use attractive technology—television or computers—which offers children individualized, self-paced learning; 2) all are funded through innovative partnerships of local educational agencies, federal and state or provincial educational agencies, and/or private business; and, 3) each school system has an advocate for technology-based education, someone capable of envisioning the possibilities and willing to work hard to make them happen. Students at risk pose difficult problems for educators and there are no simple solutions; but technology, because of its widespread appeal, can help us address those problems.

The Student at Risk: A Demographic Perspective

Harold L. Hodgkinson
Senior Fellow, American Council on Education

Thank you very much and good morning. I come from Minnesota, and in Minnesota when somebody speaks to you, you speak back to them. Could we do that just once for me. Good morning! Terrific. Get your eyes out of your notepads; you can forget that laundry list that you were making on the way home. I think I have about fifty or fifty-five minutes to talk about a lot of material, and I'm delighted with this latest version of high technology which is in front of me here. This overhead can do some really interesting stuff, which we hope to get into. I want to do three things with you. The reason that I want to do three is that that's all that you can remember. There's nothing wrong with you; there's twenty years of research on learning that shows that most people can remember three things and almost nobody can remember four. It's research that we systematically avoid, like the research that says when people can see something and hear it at the same time they remember it 15% longer; all that sort of research is stuff I take fairly seriously. The first of three things that we are going to do is get you into a way of thinking about this issue that may be slightly different from what you're used to. Secondly, we are going to look at the national trends that will have an impact on at-risk kids and on the society itself. Third, we will try to pull that into some look at instructional technology that makes sense, given the kinds of people to whom we're going do it.

Lots of folks in this country have questions about whether or not education is a system ever capable of change. Classrooms today look very much like they did in the seventeenth century. There's a lot of reason to think that classrooms don't change much; and if material doesn't even get into the classroom, then you really have some doubt about the impact technology is having.

I'm here today to tell you that institutions can change, and that when the reason for change becomes clear there is just no doubt that America institutions, kindergarten through graduate school, have the capacity to make change very, very rapidly. But we need to have a strategy for change, and most of us are not very good at thinking that way. I think the key is in learning to see the present. Futurists who tend to wear gold chains, take entrails out of pigeons, and use terror boards and Ouija have led us astray, I think. Indeed, look at what they say about telecommuting: they predicted that a quarter to a half of the work force in the United States would be telecommuters by 1990, they predicted the end of the book, all that sort of stuff. Had it come true, it is pretty clear that we would be to some extent done in.

To begin to think strategically about change we have to look at the present. If we learn to look at the present carefully, we'll see more than enough to know about tomorrow. One of the ways we can read the present is through demographics. I'll show you in just a minute how we go about doing it. In businesses we have begun to look carefully at a system for scanning the environment which allows me to say to the organizations I work with in my particular area, "Here are some things that have changed in the environment that we will have to respond to." New York Telephone Company, for example, discovered ten years ago, long before higher education in New York did, that there was a 32% decline in teenagers in their service area. It is interesting that the telephone company found out about it before higher education. What they did at New York Telephone was to immediately change their pattern of long lines of leasing, of billing, of telephone construction, because it is commonly known that teenagers don't use telephones the way human beings do.

So, one of the things we are learning to do in corporations, with real skill I might add, is to scan the environment. There is a little radar system that scans the environment, and you figure out how many times you need that scan yearly, hourly, daily, whatever, so that you can respond to problems before the situation gets out of hand. Out of that scan we develop issues and out of the issues we learn to manage them. If you go to the Harvard Business School, where I was about three weeks ago, they will teach you how to manage money; they'll teach you how to manage personnel; they'll teach you how to manage facilities; but at the moment they won't teach you how to manage issues, and that is probably the most important thing any corporate manager does. You have to go to the conference board for that. You have to go to the American Management Association for that. These are outfits that are a little ahead of others in thinking about these sort of approaches. I would argue this is vital for states who are beginning to look at future planning for the educational system, because the more we can look at the environment in the process of change, the quicker we can make an effective response.

Let's do a little scan of the education environment, especially as it relates to technology. I think if you look through the last 200 years of American history, you find that we really have three agendas. In the first we tried to extend our muscles and our bone structure so that, rather than running faster, or lifting more, we developed machines that could do those things for us. For 100 years or so the idea was to get machines to be superhuman, to go faster than we could go, to lift more than we could lift, and so forth.

About 1950 we began looking at extending human mentality or human intellectual capacity in the same way we had tried to extend our biological structure during the 100 previous year. We noticed that we didn't need rivers anymore, we didn't need coal anymore, and we didn't need steam. And so the raw materials for the second agenda was brains. And to transport brains around, what do you need? Airports and interstates. And that's why the new system, organized to increase human mental power, located almost all of the fifty-five or so high-tech centers in America on interstates within ten miles of an airport. The new raw material has shifted to brains.

The third agenda, which is just beginning to emerge, is extending the capacity of the human genetic structure, not only to remedy defects, but to begin doing some of the incredible things that those funny little critters that are now being developed can do, for better or worse. There is one microbe, for example, that has now been patented, that if you put it up in the area around Minnesota where I'm from, up in the Misabi range near Hibbing, which is full of iron ore, it would just eat iron ore all day long. Twenty below, they still eat iron ore. Doesn't make any difference. They have only one waste product. They excrete high quality commercial steel. If you think of a microbe that makes steel, with zero energy costs, when energy is 55% of the cost of making a pound of steel, you begin to get a sense of what this revolution's going to be like in a whole bunch of different ways. We've already discovered the cities that will make that happen. Just as we now know where the cities are that will make this one happen. This, then, is a way of thinking about technology because it is, after all, a fairly new environment.

We also know that since about 1950, we have been concerned about the development of human capital. We use that phrase a great deal, even now, when the debate has formally shifted to competitiveness. I think it's still the same old debate we've had, but, at any rate, we're now looking at the development of human capital. Because most economists are smokestack types, they still think of this area as sort of soft, and not really related to the hard-nosed business of economics, which is making stuff and selling that stuff to people. The service industries are systematically looked down on, and the human capital development idea is seen by some economists as being vaguely Marxist.

As we begin thinking about what we're going to do, we keep seeing all these wonderful new things. I mean, I think this is one of the most interesting and fascinating ideas I know, and that is, you can get on line with your computer through a modem and the next thing you know you're going to college. It's great for young men like this, it's great for handicapped people, it's wonderful for the largest, most rapidly expanding group in American society, which is people over 70; for those folks, the possibility of this is just an enormous bonanza. And I must confess, most of the data I use comes from Dialogue, VRS, I-Quest, all these other on-line systems in which you can get census reports out of I-Quest before they're published. Because what goes into the electronic system are the electrons that later become the publications when GPO can catch up. So that you're actually about two months ahead of time by getting these things on line.

So, as we think about where we are in this field, the research shows that kids who have had electronic learning learn faster than those who haven't. All of the study was done, of course, by the people who manufacture the electronic learning devices, but it still suggests some great big changes. We all know, I guess, that in terms of what people are doing in schools, there's just no doubt that commuters in America have gotten into the school room. They haven't necessarily gotten into the classroom. They've gotten into the school room. Go to Japan and look for computers in schools and you don't see them. They're just not there. Go to the Soviet Union, as I did about three years ago, and look for computers in schools; they're just not there. The only nation that's had the moxie to make this happen is the United States. Why? Because we're so inefficient. We're organized locally; 14,000 school boards make decisions in this country instead of one ministry of education, and who got computers in there quickest? We did. There's a remarkable efficiency that comes from decentralized democracy which we never give ourselves credit for.

Because I grew up in Minnesota, where summer is defined as two weeks of bad hockey, I played an enormous amount when I was in the Soviet Union. And because of that the Soviets let me work out, although feebly, with a Soviet B team. I have never seen anything like it. They're masters of the prepared play. They never do anything that's not part of a play. The puck is cleared at the net, and the defenseman gives a hand signal, and a play that was rehearsed thousands of times is set in motion. Within two minutes after they'd lost the puck I saw the Soviet team complete the play. Now, that is a big problem for them. It's called manpower planning. We have a different problem. Americans look awful, because we're laid back, and sort of lazy, running around waiting for something to happen. All of a sudden, a play that was never rehearsed takes place. It did at the Olympics a couple of years ago. And when that happens, people all around the world sort of jump to their feet genetically, because the name of that game isn't hockey; the name of that game is innovation. And we're still better at that than anybody else because we tolerate lots of different kinds of groups that come to our country. We're the only nation that sees pluralism as a potential advantage. Every other nation looks at pluralism as a detriment. The British are not happy with the fact that they have large numbers of Arabs working on their assembly lines. Similarly, in West German manufacturing plants, they're not pleased at all that one out of four assembly line workers is Turkish. We're delighted with that idea, because we think different cultures come to America and bring new ideas to the party.

So, that's a general background of what this means. And of course, we really need to get something in there, because the book industry is running out so rapidly; there just aren't going to be any books anymore. The only trouble with that is the data. And I know data shouldn't be used in analyses like this, but if you do look at the facts, it's quite interesting: Best year in the history of book publishing, by far. In other words, one industry doesn't drive out the other; this is not a zero sum game in which we either have books or we have computers. Most of us have both and learn to use them both more efficiently, and I suspect we will continue to do that.

There is one thing about it, however, that does bother me, and has for some time. And that is that if you look at computers, you find that there is a direct relationship between poverty in the schools and the small number of computers that that school has. In other words, devices that are supposed to eliminate or reduce the effects of race and class are being used in such a way that those differences are heightened. This is nobody's fault. It's just that poor school districts don't have as much money as rich school districts. You know that famous comment that Hemingway made about the rich—they're just like us except that they have more money. And it works in schools too.

This means, then, that if a child goes to a poor school, that is, a school that has little money per student, he or she is going to be at risk. If you want to look at it another way, the 12,000 wealthier schools are four times likelier to have computers than the 12,000 poorer schools. To take this comparison further, the white schools have twice as many computers as minority schools; and computers in low-income schools are used primarily as drill sergeants. I know we've already talked a little bit about the inappropriateness of using computers as drill tools. Unfortunately, it seems that that's the largest use that has been made of computers so far in poor and minority schools. The machine decides the test, the kid salutes, and goes to work. If, however, you look in suburban schools, you begin to find that the kids use the computer as a tool, that is, as they do a pencil. The kid frames the problem; the kid uses the computer to solve it. As a result, more and more middle class kids become more entrepreneurial, and more and more inner city kids become more passive and dependent. This is just the opposite of what we wanted this new device to do. By putting the machine into a free market system, we have reproduced the social inequities we wanted to erase.

Social class is an issue Americans do not like to talk about; we're quick to talk about race when class is truly the issue. Now middle class black kids perform so much like middle class white kids that the issue is not worth debating anymore. What we need to know is how many middle class kids there are and how we can make sure that their numbers can be increased. Also, if you think about computers, and look at all of the things that we know about what correlates with learning—I'll just put a few of them up here—I mean if you start thinking about where computers will be most effective in schools, you have to put it mildly, a multivariate problem.

I think we tend to be simple in our view of what the market's going to be like, when we say they're eight-year-olds or nine-year-olds or ten-year olds, without looking at the enormous range of things that we need to look at. In addition, in some schools the agenda in the blue words is the most important agenda; in others, the red words are most important. What matters to almost every teacher is the way those two sets of words go together.

When I talk to Rotary clubs, which I do at a necessary minimum every year, they tell me they want the schools to do only the blue words. If the schools would do those, they say, everything would be just fine. To them schools are like a museum of virtue, in which students are paraded by all these sort of antiquated things that adults don't have time or inclination to practice, but want to make sure that the kids do. Many people active in their community will say that the red words sound vaguely communistic. They think there's something about those words that's dangerous. The only thing is, almost all the red words appear in the Bill of Rights to the Constitution, and almost none of the blue words do. They would probably think that the Bill of Rights is a pretty radical document, too.

As we think about all of the devices we could be thinking about, I guess the pencil is the most radical, the printing, blackboard and the overhead, incidentally, which ended up in movies. (Does anybody know where this particular old device—the overhead projector—started? Anybody who goes back to World War II? Biggest sport after World war II? Bowling. Big problem. Nobody could see the scores. In a tournament, there are only these little groups of people down here who are doing the bowling who knew their scores; the rest of the people can't see the scores. A bowling operator in Indiana said, "Why don't I put this up on a screen, and then we can see what the scores are." The overhead was used in a bowling alley in 1949. And when did it get in the public schools? Twenty years later. And that's a world record, folks. Nothing's ever made it faster, and no machine has endured longer, except perhaps the blackboard, then the overhead. And the overhead is in almost all classrooms today, and therefore, it is not a device to be ignored.

But if we look at these others, one of the things that is consistent with all of them is that everybody who pushes them says they free the teacher to do those things that can only be done by human beings. I remember hearing B.F. Skinner say that when I was at Harvard. Somebody said, "Mr. Skinner, what are those things that can only be done by human beings?" He said "Don't bother." So, as we look at all of the work that we're going to do with computers, and we hear it said that computers will free the teacher to do those things that can only be done by human beings, we must know what those things are. We cannot answer "Don't bother. " Unless we can define them, the argument needs to be very much reconsidered.

So much for computers. Let's look briefly now at some of the demographics that we'll have to worry about. I'd like to start with the world, because we are part of it. The world is now at a very large number—5 billion people. We know that we can feed it, but if you go back to the literature in the seventies, it was in doubt that we could ever feed that many people. We can feed more than enough, because some 400 million tons of foodstuffs are being stockpiled at any given moment in the world. Birthrates are coming down. Fifty-eight percent of the world lives in Asia, where there's a huge middle class forming. American business leaders, with whom I spend a little time, systematically ignore India as a market because India is known as being very poor. Which it is; only 7% of India is middle class, but 7% of the Indian population is 55 million people. India's middle class is larger than the entire population of France. This is an enormous potential market, and yet we don't think of it that way; our tendency is to think of ourselves, Europe, and maybe some of the little dragons.

China's middle class will become a major consumer in about 15 years. That is, instead of buying Coca-Cola and little kinds of flimsy things from us, as they are now, they are going to be buying air conditioners, color televisions, and all kinds of things, because the Chinese save 20% per year, and that's more than almost anybody else. We're 5% of the world; Europe is 10%. At the turn of the century, the NATO countries together made up 30% of the world population. Today they make up about 15%; In 2020, the number will fall to 9%.

Can the West lead the world if we're 9% of the world's population? It's worth thinking about. Nine out of ten children born today are born in a developing nation. As you push that one around, you get a clear sense of the kind of world in which we're going to live. I believe it's very important to think about that world, because we are indeed influenced by what goes on in it. The average fertility rate in the world is 28 per thousand, not up much. In China, it's 21. That's devastating in China. It's up from 18 three years ago. And when the Chinese go up per thousand, remember it's a billion people. The multiplyer in China is one billion. It isn't three kids, it's three times the billion, as you get into the math.

Africa has the highest fertility rate in the world, and that's dangerous because Africa cannot feed its population. It's the only continent that cannot, and we're going to be in some trouble there. This all started because after World War II when ARCON expanded by selling to an expanded Europe and to us, because our fertility rates were up to the level of 2.8 children per female. When we hear that the present Mexican-American fertility rates are as high as 2.8 children per female, we have to remember that that's exactly the Caucasians' fertility rate in this country right after World War II. So, I would argue that the world is a nice way to think about these issues.

Let's look now a little closer to home. A finding appeared in an article in *U.S.A. Today* in 1985. (This was seven years after it was know, but that's not too bad for that particular paper.) The finding was that California is going to have a minority majority by about the year 2010. As it turns out, it is a little closer than that. How did they get to that astounding conclusion? The looked at the numbers of very young children in California, and at their race, and discovered that a majority of young children in California were non-Anglo. And then they said, what are those kids likely to do? They're likely to grow up. It's a simple trick that many of us have learned to do, some of us in this room. But by doing that, they automatically become the major cohort of the adult population. You cannot do anything to that cohort in terms of add-ons, except through immigration. You can kill them, but you can't add to the numbers that were indigenous to that population. You cannot be born 18 years of age at birth; it's against the rules. Once that cohort has been established, that's it for that year, folks. Those people get older. The predictions that you can make from this kind of system totally confound the economists, because of the fact that you can predict to the year 2000, plus or minus a quarter of one percent, most demographic national issues.

Looking at that scan of the environment, a clever educator built this issues-management statement. It's true, he said, that California's going to have a minority majority in a very few years; and, he said, the University of California is not very good at working with those folks. It doesn't meet their needs very well. So, he said, if this university doesn't shape up by the year 2000, it isn't the young people that are in trouble, it's the university. That's the issues-management statement. In response to it, you see, they started early on to articulate high school graduation with going to college, so that more minorities would be able to go. They did this right out of sheer self-interest; they want to have a large student population to themselves, articulating the number of two-year students who can transfer to four-year programs and on through.

This, then, is a good example, I think, of an issues-management statement coming from an educator on a demographic issue. The conclusions are quite tidy, because these kids have already been born. They are coming toward the schools in large numbers. They have not yet reached the schools, but if you look at the birth cohort this year, it's significantly different from the group that is now in third grade. Between third grade and birth, now, going down, we have a striking shift, in terms of what's coming toward the schools. Looking at that, then, we can see with some certainty that we will have some teacher shortages in American schools in all the areas that are increasing.

Right now about 14% of the youth has been classified that is analyzed as being handicapped or ready for special programs. The percentage is probably higher than that, but we haven't been able to get the analysis done yet. The uses for computers in that area, I think, are just astounding; the possibilities for major gains in computerized work with the handicapped are going to be realized, but there is still going to have a teacher shortage.

Speaking to about 900 hundred people at ASA earlier this year in San Francisco I asked how many were having systematic difficulty attracting teachers to your schools? Nine hands went up. Then I asked how many work of them worked in big, poverty-stricken, inner-city schools. The same nine hands. But when I asked how many of them had more than 50 applicants for every position available on their teaching force, about 700 hands went up, and the same 700 went up when I asked how many of them taught in wealthy, suburban schools, well away from the big cities. We still have some class differences throughout our school systems. Each state will have a different interpretation, because each state has a different need. We now build two separate budgets, one for public schools and one for higher education, that go to the governor's office without much conversation at all. Some states have begun to move with some effectiveness in getting some loose coordination of that big budget—Connecticut's one that comes to mind. They are trying to at least make people aware of the total budget for education, which is by far the largest item on any state's budget process. There are also states putting in extra funds for a maximum return. I'll give you three examples: New York, Pennsylvania, and Oklahoma.

New York is very poor at graduating young people from high school. They kill themselves at education, they overspend, they've got lots of skills and dedication, but they're 46th in this country in the numbers of students they graduate from high school. That's New York's problem. Pennsylvania, just around the corner, has almost identical demographic measures, but just the opposite problem. It graduates a high percentage of young people from high school, but very few of them go to college. Pennsylvania's problem is to get more high school graduates to go to college. The New York problem is to get more young people through high school. Once they get through high school in New York, their chances of going to college are almost one to one. New York is very, very sophisticated about getting high school graduates into college.

State number three, Oklahoma, discovered that they have a very large number of kids eligible for Head Start for whom there's no program. A bill currently in the Oklahoma legislature says that the state should make sure that every Head Start-eligible kid has a program, because educators have discovered that Head Start makes a huge difference for these kids. Three states, three different targeting mechanisms trying, with limited extra funds, to get the maximum back for their buck. This seems to me to be terribly important to think about. I'm worried about the work force.

This is our pride and joy in Washington, D.C.; I ride it every day I'm there. It's the Metro. One look at it and the assumptions behind the system should leap out at you. It is fundamentally a hub-spoke system designed to get commuters from their suburban houses downtown where they work. And why do they work downtown? Because that's where the jobs are. At least that's where they used to be.

The problem with this system is that in Washington 40% of the new jobs in the last decade—and that's a lot of jobs—have been located here, here, here, here, and here—in the suburbs. Think of a system designed to get commuters downtown being used by 40% of the new jobholders as a way to get from Silver Spring to New Carlton, which is where about 11,000 people now live and work. They could get to work quicker by walking on their hands than they could taking the Metro. What do they do instead? They use this system out here, which is the Beltway. They get their cars to the entrance ramp, a pleasant two and a half hours later they can get out of their cars, but they can't park them. And the reason they can't park them is a limitation on parking space in New Carlton imposed by the legislature. The idea was that undesirables would ride the subway to the end and get off at the last stop, and there would be muggings in the parking lot and all that.

I live in Alexandria. King Street is my stop, and at King Street, right here, there are about 14 parking places. About 1100 people use the stop every day. It's like a museum; we go by the parking spaces and wonder how they are today, but nobody ever uses them. Next to the parking places there's a little oval that says, "Kiss and Ride." The point of "Kiss and Ride" is a very simple one; the suburban Hausfrau drives up in the station wagon, lets the husband out to go downtown to work, and she goes home to take care of three children. Although that profile now fits only six percent of the Alexandria population. It's still in use. Why is it, then, that so many people are now commuting into Alexandria to go to work? Alexandria now has more jobs than households, which means that people are coming out here to work.

Places like Alexandria and Glenmont are becoming major urban centers. People who live in Glenmont come not into Washington, but into another city, Silver Spring, to work and then go back home. Why is that all happening? Because 68% of the people in the country are in services, and services are quintessentially portable. If you're in real estate and you don't like your office, you can move over a weekend. But if you're at General Motors and you don't like your production plant, out in Dearborn it will be three years before you can get something else lined up. Services are portable, and therefore you can leave the big city, with its high rent per square foot, and you can move out where costs are low, environments are nicer, and services, obviously, should abound.

You may think this is just in Washington, or that Washington is an aberration. And it is, sort of. John F. Kennedy once said it was the only city that he knew that combined Southern efficiency and Northern charm. But the same thing is happening in Chicago. In 1980, 47% of the Chicago commuters were going from a suburban home to a suburban job. And that's why the beltway jams first. People were supposed to use it to get to the nearest spoke, but now people are staying on the beltway to get to their final destination. The average trip that was supposed to be 14 is 50. That's why those aerial pictures of the city at night show that while most of the inner city streets are relatively passable, the beltway is absolutely jammed up. People are staying on it three times longer than planned.

We have generated an enormous number of new jobs, more than the rest of the world combined. But, if you look carefully at those jobs, you will find that a very large percentage of them pay very very little indeed. Two fifths of the new jobs, for example, pay less than $7,000 in 1986 terms. That's terribly important for our future. If you look at college graduates in America, you'll find that 20% of the people who graduated in June 1986 got a job that required no college education at all. The consequences of that for minorities are particularly dire. If we increase aspirations for minorities in America, as we're doing now, but do not alter the job structure to create large numbers of middle class jobs for those folks to move into; or, if we do not make it possible for bright black high school graduates to afford college (and, thanks to this administration, they can't get any help because it's all going to be loans and none of it grants), and they instead go to work for strictly economic reasons only to get the same job that their parents got with a third-grade education— then there are grounds for questioning the system, to put it as mildly as I can.

What's been happening in the country is a major shift out of the middle class. Most people are still middle class, but there the action on the extreme. Many people are moving up to the upper middle class, but a more significant number of people are moving down. We need to look at that very carefully in the future. It's my belief, based on the trends seen in this downward mobility data, that we have the potential in this country for a permanent underclass. We're not there yet, but if you look at Nicholas Lehman's material, you can get a sense of the possibility.

Here are two facts that don't seem to be consistent, but are: Number one, most Americans are middle income; and, number two, the action has all been on the extreme. Both are true. And it's nice that so many are moving up; that is obviously a Yuppy population. But who makes up the other population, those moving down? There are in services, which is where almost 30% of the work force now is, and in service 41% of the jobs pay less than $15,000 a year. Are they going to be able to support two kids and aspire to have them go on to college when the income is at that level? I'd be very surprised. Those in manufacturing can realize such aspirations. A turret/lathe operator at General Motors can aspire to send his kids to college, because he's making $14 an hour. But can a maid cleaning up a hotel like this one aspire to have her kids go to college? Not really, because the service industry does not have a middle class.

I'll give you two examples. Burger King, for whom I do a lot of consulting, has 140 people in corporate headquarters. Everybody else works the counter, except the franchise owner. There is no middle to the Burger King work force. Federal Express: there are 140 directors in the company; everybody else is a courier. And indeed at the last senior meeting, Fred, the boy genius who started Federal Express, was heard to say, "there is no room for Deans at Federal Express. We don't want a lot of high-paid, middle management stuff that nobody knows what they do for sure. Let's just keep it lean and mean."

Now corporations keep the service work force lean and mean, the way the manufacturing work force used to look. Remember 1900, when manufacturing workers didn't have any say in decision, when they didn't make much money, and when there were no upward mobility jobs, no ladders? That's changed. Manufacturing now offers upward mobility. It has a middle class. The Japanese manufacturing work force looks more like this all the time. The average Japanese worker is not getting 70 cents on the American worker's dollar. But in services, it's different. You have to build a middle end of the service work force, and that's a job for about ten years.

At the moment, the people most likely to get service jobs, which are low-skilled and dumbed down, are minorities. Those are the people who have always done these jobs. And, if you look at the number of janitors compared to the number of computer programmers, you get a clear sense of why that's important. In 1980, there were 30,000 new jobs for computer programmers, and 600,000 jobs for cashiers. For every opening for a computer programmer, there were about 22 or 23 openings for cashiers. If you think about what cashiers make in America, compared to computer programmers, you can see that the job structure is building in a very large number of jobs that don't pay much at all.

The Burger King cash register takes three hours to learn, and Burger King wants to cut it down to two. The less math you know during training, the better Burger King likes it, because being a cashier has nothing to do with math. The job has been dumbed down. They really use that term. And why do they dumb down a job? So they can get people to do it in families. What would you do? Probably the same thing. This is the way in which our economy is generating new jobs, and it is a great big issue. It may look to you like an aberration, but look at the total number of workers. These are not new jobs, but totals for the country. We need to be concerned about economists and lawyers, but, as you can see, a giant chunk of the 97 million workers is made up of food prep people and janitors and secretaries and cashiers. What kind of an education should a future cashier get? That's a question we need to ponder, because there's going to be a lot of them around.

I want to look, in closing, at age, region, and race, in that order, and how they mix. Our major national calamity is the drop in teenagers that will take us down about a million more until 1998 when it begins to turn around; we'll talk about the turnaround in just a minute. All of the age-related industries—music, soft drinks, all the kinds of things that appeal to teenagers—are therefore having a tough time. We're running out of teenagers. You've probably all seen the McDonalds ad with the older guy who goes to work at McDonalds and greets his wife on the way home saying, "I don't know how they ever got along without me." It's a terrific ad. It's not designed to encourage more older people to come to work at McDonalds; it's designed to lower the customer resistance to buying a Big Mac from somebody who looks conspicuously like your grandmother.

They've done studies in which people have walked into a McDonalds, found a 70-year-old matriarch behind the counter, and turned around and fled; that's not who you're supposed to get Big Macs from. We thus have a big problem in business, and likewise in the military: how are we going to keep a standing army with about 2.5 million in the youth force? And, if you're in the newspaper business, who's going to deliver your newspapers to homes? A 14-year-old freckle-faced kid on a bicycle? No, this is no freckle-faced kid. This is Alice Doshieo. She has three children. She's working her way through a college degree because she's not eligible for any federal aid; she can't even go half time; and, as you know, half time is the cut point. As a result, Alice, who's 42, has a paper route, because her husband left her.

The future of the country is very clear. Those who make up the majority of the future population have already been born. When you look at data, you don't have to think too much about where the growth is going to be. Seventy million baby-boomers are now between 24 and 40, and what are they going to do? They're going to get older. It isn't just little kids; almost everybody does it. And, as a result, when the baby boom gets to be 80, which it does right here on the chart, there is an after-burner-on-the-rocket phenomenon, and things really begin to take off. That group becomes the most rapidly growing part of the American population. Since 1983 there have been more people over 65 in the United States than there have been teenagers; and, as long as you live that will be true. They've already been born, folks. Nothing can change it. If the birth rate doubled tomorrow, it wouldn't make any difference. The importation of five million Saudi Arabian one-year-olds tomorrow wouldn't make any difference. This is the way it's going to be in this nation of youth, abundance, physical energy, and throw-away natural resources. We're going to have more over-65s than teenagers. Nothing can change it. A final comment about age: you probably all remember "the war," "my war" was World War II; 70 percent of the population does not remember World War II, because they weren't born then. We need to keep thinking about those cycles. In your handout you have a publication called *All One System*, which may help.

So much for age; let's look at region. This should help you a little bit. Anybody recognize anything up there? Yeah, it's the United States, but there are 28 more things up there. They are population densities. Where are they located? Two excellent answers, and nobody said Boston, which is the wrong answer, but people from Boston always say that. Number one is the East Coast. Seventy-four percent of retail sales in the United States occur east of the pencil—74%. The East Coast accounts for a third of the land mass, but 74% of retail sales. Are they wealthier in that area? A little bit, but that's not it. There are simply more people there. If you wonder why Californians seem so concerned with their own affairs, and care less the rest of the nation, it's because. they have to build their own nation, a nation apart. If you go east from California, it's a long time before you see any lights. Ten years ago, all the futurists were telling us that Wyoming was where it's at, because Wyoming had a 33% increase in population. Well it did, but in Wyoming 33% is seven people.

Population densities also occur near water. Look at the percentage of the population that's within 100 miles of an ocean or a great lake. That's 69%, a handy fact if you want to sell them things, especially boats. If you go from St. Louis up toward Ohio do you notice those little spiderwebs; can you see that spiderweb? What's that? Interstate highways, excellent answer. And what's growing along that little spiderweb? The new suburban growth corridors. We find service industries on one side of the highway, and nice new condominiums on the other side; nobody goes to St. Louis anymore. These new suburban growth corridors are becoming self-contained urban areas. In 20 years, the East Coast will look like this. This is not Boston, by the way. It's called Boswash. It extends from Boston to Washington, and functions as a single city because of the enormous densities in that area.

The average density in New Jersey is a thousand people per square mile, the same as the average density in Japan. The reason it works here it the same reason it works in Yokahama. It has to. When a million people want to get on the subway, it had better be on time or somebody's going to get killed. Densities, then, demand efficiency in the delivery of services. So this thing works because it's so dense (that's not SAT scores, it's people per square mile). The other reason it works is that it doesn't have a mayor. If we made a city out of this, we would kill it immediately. The reason it works is that it has to. Ask anybody who lives in New Jersey where the Pennsylvania line is and they say, why would anybody want to know that? It doesn't matter. New Jersey and Pennsylvania are all basically the same thing; the census tells us that. A final thing you can learn from this is why Delta Airlines has made money every quarter but one since it went into business. The answer is crystal clear: Even if you're going to go to hell, you have to change in Atlanta.

As we think about our population, we find that megatrends predicted some things that are turning out to be quite wrong. Number one. There are in this country 240 million people and four time zones. What percentage of the 240 million people live in each of the four time zones? Kind of fascinating. Half of our population is in the Eastern time zone. Thirty percent in central. Five in Mountain. And fourteen in the West. As you've seen, the West is almost all California; once you take California out of the picture, there's almost nothing else. This fact is terribly important as we look at the future, because the movement to the west has come to a historic slowdown. These ten states on the East Coast have half the teachers in the United States. That fact came onto my computer about six months ago. I was fascinated by it, because I didn't quite believe it. I said, how about engineers, how many of them are in the same area?. Those ten states have 60% of the engineers. I said, how come they're so high on teachers and engineers? Then I tried toothpaste. And lo and behold, those ten states had half the toothpaste. Well, then the light dawned—I'm a little slow about this; those ten states had half the people in the United States. Half the population of this country lives in ten states. And where do politicians go in the last week of the presidential campaign? Do they go back to Fargo to clean up Fargo? Nope. They go to those ten states, because that's where the votes are.

Also, as we look at region by income, it's very clear that the Sunbelt simply doesn't exist outside California, and Alaska, which is kind of freaky because of the way the state's laid out. You don't see the Sunbelt up here and indeed, if you look for the incredible turnarounds on income have occurred, you find them in the Middle Atlantic states, even though everybody's been saying things like "Will the last person out of Detroit please turn out the lights." The reality has been quite different from the predictions. Indeed, in 1986 more people went from Texas to Michigan than went from Michigan to Texas. The economy of Texas is in worse shape than the economy of Michigan. More Texans bet on Michigan for getting a good job than Michiganders bet on Texas. So, that historic movement to the west which Tocqueville talked about in the 1830s is now coming to a halt. Nobody knows where the next major, historic movement will be, but for now it is no longer westward.

Two final comments about region. There is one dot on this map for each community college. Community colleges enroll half the college students in the United States. How did they accomplish this? One look at the map makes the answer crystal clear, and, as you can see, this isn't distributed evenly at all. In many parts of the United States this is becoming our most serious poverty problem, although the Secretary never refers to the data, it is true that 40% of the poor in this country are children and 10% of the poor are elderly. If you think of the fact that 25% of the kids in this country are going to be below the poverty line once during the next two years, you have a real sense of a major national emergency that's being ignored.

Here then are the 28 strip cities in which most of us are going to live, and this is where we can find a new phenomenon, and that's the black middle class. Now these are still part of the city, but if you want to find out where black middle class people are living by suburban residency, this is the percentage for each city that is in the suburbs of that particular city. (This is in your handout, you might want to have a look at it at a later time.) Miami's number one, Chicago doesn't make the top 25. It's very difficult to do that in Chicago. This is residency. If you do it by income, Miami drops to number two, this is from the joint center, but this is a clear statement of where the black middle class is. It's alive and well. And my feeling is that it's the best thing that's happened to this country for a long time, because unless a minority group develops a middle class, they can't truly become a part of the United States. This is why I'm so concerned about the decline in middle class jobs. If there aren't jobs for minority people when they get through high school and college, then there's a great tendency to look down on the system—I would, too, if I were in their shoes.

This, then, is an indication that a fair number of people are moving into a black middle class. We're seeing a lot of both black and Hispanic small businesses; and we now have 286 black mayors in the United States, of whom a third are mayors in cities that don't have a black majority. These trends make us very optimistic about the emerging profile of the black population. In Alexandria, where I live, the house across the street was vacant until a black couple moved in. He's a psychiatrist who makes about $105,000 a year, and when he drove up in his Mercedes with his lovely family to take possession of the house, he was integrated into Alexandria society in about five seconds. Our values are quite clear: if the guy drives a car like that, he must be a nice guy. Everything was just fine until at our first black party, this matriarch of southern society came up and said, "Dr. Jones, it's just marvelous that you've had all this advanced education so that now you can go back to Anacostia and help your people." He was just wonderful. He put a deft hand on her shoulder, smiled at her, and said, "Ma'am, you're my people now." So, at this time, there is a black middle class; things are beginning to look up. The black poverty group is still very large, and a major national calamity, but there's evidence that things can work. Nobody, at least, has made the genetic argument to me for at least four years because black middle class kids do so well.

Black kids are now deciding to graduate from high school; they may not, however, be able to go to college. This is the most pessimistic thing I know. You look at the traditionally black colleges: 30% of their students are from families with an income below $6,000 a year. If your family income is $6,000, and you need to take out $40,000 worth of guaranteed student loans from this administration because they won't give you a penny of grant money and work-study is being cut back, what's the likelihood that they'll go to college? Not very good. That bothers me. We are all too likely to go through this roller-coaster and back to the beginning once more. Our concern with excellence has put higher education so far out of reach that equity is once again a clear problem and resegregation is taking place all across America. Look at the class action equity suits now. Look at the facts that about fourteen states are under court order again for desegregating colleges. We went through this for twenty years and now we're going through it again. This suggests a new way of looking at American educational issues. Satchel Paige defined it the best of anybody. He said, "It's just déjà vu all over again."

We've done exceptionally well in getting people through the system. The system itself is better than ever. About 53% of a class of fifth graders can anticipate going to college. We got no accolades for that, and some states do it a lot better than others. Those states that have the highest rates of retention are all cold, Calvinistic, sort of virtuous by default. In Minnesota, for example, if you do anything fun you freeze to death immediately. The successful school systems are small towns, small schools, and small classes. Everybody knows you name. (It's disgusting. But you can't get lost. Everybody knows where you are. When I took the family car for the first time when I went out on a date as a sophomore, nine people called my father the next morning to tell him what a good time I'd had the night before.) That's simply the way it works. Look at the low-retention states and you get a very different picture: Ethnic diversity. Big centers of poverty. Big cities. Big schools. Big classes. The largest classes in the nation of any state of any size are in California. The average class there is 23 kids. The kids in California public schools speak 120 different languages and dialects. The sad thing is that we know how to make this all work. We can get everybody up to the Minnesota level of retention if we wanted to. We've got the techniques. There are no surprises up there. It's very simple.

But simple things are not easy—they're just simple. High-jumping thirty feet is a simple concept to understand, but try doing it sometime.

So as we look at the country, we're beginning areas in which youth populations are increasing and will continue to do so for the foreseeable future. This is a part of the country in which minority youth are a growing percentage of the school kids; it is a part of the country in which the numbers of immigrants are increasing. Look at the increased immigration in Illinois, the only state in the Midwest that pretends it's a coastal state. Our government has said to us that those youths have three things in common: 1) poverty; 2) lack of English-speaking ability; 3) an increase in physical and emotional handicaps. Those three things together will make these states have to run a lot harder just to stay even in school achievement. The challenge for them is very, very great. There's enough time to meet the challenge if we get going now.

Let's put together age, region, and race. The counties in red are counties in which a fifth of the population is over 65 right now. This is not projection; this is 1980 census data. There are some big surprise there. We know, for example, that Florida's population is old, but look at this. In all those counties a fifth of the population is over 65. Iowa is our third most rapidly aging state. When Willard Scott does the weather on *The Today Show* and congratulates Aunt Fanny for making it to 100, Aunt Fanny almost always lives in Sioux City. It can't be the same person is changing her name every night; it must be something else. Why is Iowa one of our most rapidly aging states? There must be a reason. Is it because older people are moving to Iowa to retire? For those wonderful Iowa mountainside resorts? For the world-famous seashores? And concert symphony orchestras and restaurants? No. It's because young people leave Iowa as soon as they can get a driver's license, and they head this way. The migration of youth out of Iowa, Kansas, and Missouri is a major national issue. It's beginning to force a conflict between the generations in this part of the world in which older people are saying—and I heard this just two weeks ago at a school board meeting—"Why should I be concerned about the education of somebody else's children?" Think of that. That has a whole lot to tell us about the future.

If that's where older people are concentrated, where are the greatest concentrations of kids? Those counties where 34% of the population is under age 18 are indicated in red. No state has it all the way to the boundary except Utah, which is a highly special case, showing what a population can do when it's dedicated to the idea of keeping itself going. One of the areas in which the numbers of youths are increasing is the Southeast, where the black population is still very heavily concentrated. I'm always amazed at that map, because I thought the black population had pretty much moved out of the South; but, it's not been the case. The numbers of youths are increasing among Hispanics as well. These increases are not due to increasing minority fertility, because minority fertility has not increased. The problem is a decline in white fertility; it is down from 2.8 to the current level of 1.7, and still dropping. This little baby boom is over. It ended in 1986. This is the hope of every superintendent in the United States who saw that increase and said, "Boy, that's in my town." And three-quarters of it are in the five states that we just looked at. Here then is a way to think about the problem. Baby boomers appear to be very concerned with themselves, partly because they are having such a tough time in establishing an identity.

I was born in 1931; almost nobody else was. My whole life has been spent walking into half-empty buildings, like elementary schools and high schools and colleges. And, I've said to people, you know, "Here I am," and they said, "Come on in, we need you; there are only three people on our basketball team." No baby boomer's every heard that said. I played sandlot baseball as a kid. My first day out I played every position. I remember pitching to my grandma because she was the only person we could find. Every age group was represented on the field. If you played baseball today, you played Little League. And if you played first base, the coach would be inclined to say, "You don't like it here, you can leave, because there are seven other kids who want your spot." Nobody ever appealed to me that way.

The baby boomlet, therefore, is in these five states, three-quarters of the boomlet in these five states is overwhelmingly minority. This increase, then, if you look at where it is, is adversely proportional to the white population of the given area. The problem here, then, is not minority fertility. The problem is Methodists. Now these folks have an average fertility rate of 1.4 children per female, you need 2.1 to stay even. The consequences of that for all of us are just crystal clear, I think. The fact that the NATO countries are going to represent only about 6% of the world's population by 2020, is largely because of this pervasive, rapid decline in fertility. In Israel, there are 3.5 million Jews and 2 million Arabs. However, there are more Arab children than Jewish children, and that's been true for eight years. If it's true for four more, there will be an interesting possibility of an Israeli army with an Arab majority. It breaches now what the good founders of the country had in mind. That's why Prime Minister Perez said a year ago that each Israeli couple should have 4 children to protect the future. Unfortunately, you can't change birth rates by edict from a prime minister, though it's sort of a nice try.

Our particular problem is that the baby boomers who are in the peak childbearing years, 24-40 are now not having children. They are staying single, and, when they do get married, one of their marriage vows is the vow never to have children. This is the four-year-old's view of the world. The baby boomers have set a getting and spending agenda. This is when you get your house, this is when you get your promotion, and all those things. The Bank of America has 400 people with the title Vice President, because they have to promote 70 million baby boomers; they give them a title because it's cheaper than paying them more. So, the baby boom looks like this: "We've made our freedom, our choice for freedom and spontaneity. Our cats can take care of themselves and we're free. The world's a crazy place to raise a kid." These two yuppie, baby boomer dinks—**d**ouble **i**ncome, **n**o **k**ids—blowing bubbles on a Friday night, say "I find the whole idea of pregnancy repugnant." Well, Charles Darwin had some things to say about any species that found the idea of reproduction repugnant, and that's probably the best explanation there is for the dinosaurs.

All of our major city schools have a minority majority and we have a new phenomenon—an excellent, high-quality, inner-city, minority school. And you can find them all across the country. Minority doesn't mean "bad" any more than "black" means "poor." We must have more complex ways of thinking about these realities because they are getting very, very complex indeed. In Texas, 46% of the kids in the Texas public schools are not Anglo. I had the exhilarating pleasure of telling the legislature there that if 46% of the youth population flunks out of school in the tenth grade, goes on welfare as soon as they are eligible, and stays there until they're 65, no Anglo-Texan will be able to retire. There isn't that much money in the world. Casper Weinberger doesn't have that much money in his budget. They did not like to hear the news, but they did ask me to come back after they've worked out the mathematics a little bit.

Many states in addition to Texas are approaching a situation in which at least a third, and usually more, of the youth of that state are not Anglo. And remember, it's not that Hispanics are so prolific, it's that they are so young. The average Hispanic female is just moving into the childbearing years and more are coming behind. If that female has 2.4 children, we are going to have a nice baby boom among Hispanics. They don't need to have 5 because of age. A younger population will have more children because, obviously, younger people have a higher fertility rate than people over 65. The average white female in America is 31. The average black is 25, and the average Hispanic is only 22. Who's going to have the most children? Not the white female. At 31, she's going to go on to something else. There will be a 150,000 first births to white professional women a year, but they will also be their last. And, out of 3.5 million, a little, tiny group of 150,000 children born to white professionals—the so-called yuppy puppies—is just not big enough to change things very much. The white population is beginning to look middle aged; it has this big bulge in here. This is 70 million people— 70 million people— all hatched as a tribute to the end of World War II in a baby boom that lasted 17 years.

European nations had a baby boom, too, but theirs only lasted five years—why did ours last 17? Nobody knows. The leading edgers are now 40. In the next decade, the big show crowd is in their 50s, and in the year 2000, the baby boom starts to retire. Muriel Samuel retires. And by 2020, all the people above the pencil are retired and all the people below the pencil are paying for it. They've all been born, folks, that's not economics, that's demographics.

When my father retired, 17 workers paid his social security benefits. The current rate is 3.4 workers per retiree—when I retire, the ratio will be 3.0. Of the three workers who cover my social security benefits, 1 of 3 is going to be a nonwhite worker. We're almost there now, if you add black, Hispanic and Asians in the work force. Suddenly, there's a new truth that bursts into my consciousness. It's vital to me personally that minorities in America get a good education and a splendid job. I don't want my kid flipping some hamburger in some Burger King, thanks very much! Corporate vice-presidency is none too good for my kid. Now, this is a new argument. Pragmatism and idealism have come to the same conclusion, which is, if a third of our population do not do well, the future of the rest of us is severely eroded. That's a message we need to hear, because when a person like the President of American Can Company, Bill Woodside, comes to Washington to testify in support of Chapter One of the SEA, is he doing it because he's a bleeding heart liberal? Not on your life! He's doing it because he runs a Fortune 500 company and he sees Chapter One as the most important piece of legislation that Congress is going to consider this year, that's why. Things have changed, and as this change goes on, I think we are going to have to find a new support mechanism that we've not used before. Tocqueville calls it self-interest correctly understood.

If you grew up in Minnesota, as I did, you understand the term: if your car is in trouble in the winter time— and it's called the dead of winter, a wonderful term—you have about two and a half minutes before you freeze to death. Nobody freezes to death in Minnesota, nobody. And the reason for it is crystal clear. The Minnesota patrol asks every year and people say, "Well, if I was in trouble, I'd want somebody to stop for me." Is that the ultimate in selfishness, yes or no? If you get a whole state acting as if people cared about each other, then pretty soon they do. It's curious how imitation leads to identification. This country is the most famous volunteer nation in the world. The American people donate their time to Blue Cross, to United Way, to running for school boards, and that virtually unique voluntary sector of America acts out of self-interest correctly understood. It is a complicated idea. It is not simple-minded to do a barn-warming, because if that barn is built, the community is benefitted and you, in the long term, get benefits, too. That idea is at the heart of the genius of this country.

As we think about technology, we have to look carefully at the kinds of populations that are now moving into the main stream. If we don't deal with their needs, the future of everybody in this room will be severely diminished. And I'd like to argue on that basis if I can. Thank you very much for your attention, and best of luck.

A Closer Look at the Student at Risk

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Almost every professional and governmental organization with an interest in public education is currently engaged in a study of students who are at risk of school failure. The reason for this widespread concern may have been most clearly stated in *A Nation Prepared: Teachers for the 21st Century* (Carnegie Forum on Education and the Economy, May 1986).

> If our standard of living is to be maintained, if the growth of a permanent underclass is to be averted, if democracy is to function effectively into the next century, our schools must graduate the vast majority of their students with achievement levels long thought possible for only the privileged few.

Although the term "at risk" is relatively new, the children to whom the term refers have always been a part of American public education. Certainly the children of the immigrant groups which arrived in America during the last century and the early 1900s were at risk of not succeeding in the public schools. They had language barriers and often came from families whose cultures and values were different from those for whom the school system was originally designed. American schools had originally been designed as private, church-related institutions to educate a rather homogeneous group of children born to the upper class. Not until at least the time of the Constitution did the need for more universal education as the foundation for democratic government even begin to be recognized. During the Agricultural Age, which lasted until the late 1800s, it was often necessary for young people to leave school in order to help with their families' farm work, which reduced opportunities for formal education. The depression years of the 1930s produced another group of students at risk, as did the disenfranchisement of migrants in search of a new life and the northern migration of black Americans.

Who are the at-risk children of the 1980s and 1990s? In many respects, they can be described as the children of a new American family phenomenon. Research on at-risk students suggests that they tend to come from single-parent homes and from families with low socioeconomic status. In 1955, 60 out of every 100 American households consisted of a working father, a housewife mother, and at least two school-age children. By 1985, that same type of family accounted for only seven out of every hundred American homes. According to Hodgkinson's recent study (1985), 59% of the children born in 1983 can be expected to live with only one parent some time before reaching the age of 18.

Today there are fewer adults present in the home than ever before. Between 1948 and 1974, for example, the percentage of married women with school-age children who were in the work force grew form 26% to 51% (Bronfenbrenner, 1977). The rate is much higher among women heading single-parent households. In the 1980s, mothers of infants and preschool children became one of the most rapidly growing groups employed outside the home. Other major changes have also had an impact on the number of adults present in the home to share child-rearing duties. Census data indicates that since 1948 there has been a steady and significant drop in the percentage of "extended" families in America. No longer are grandparents, uncles, and aunts as readily available to provide adult support to children. Finally, the number of single-parent families has grown dramatically.

Demographic data suggests we are an aging population. Yet all groups are not aging at the same rate. The average age among American blacks and Hispanics is significantly lower than the average age of American whites. As a result, it should not surprise us to find that birth rates among blacks and Hispanics are higher than among whites, and that the proportion of blacks and Hispanics in our population is expected to grow in the coming years. Research on at-risk students indicates that they are disproportionately black, Hispanic and American Indian.

Besides these demographic characteristics, a number of school and personal/social factors also characterize today's at-risk student. Poor academic performance is the single best predictor of who drops out of school. According to the U.S. Department of Education (1983), students with a D average are five times more likely to drop out than students with a B average. Poor attendance is another important characteristic. Aaron Pallas (1984) has found that chronically truant high school sophomores are 40% more likely to drop out than are their regularly attending classmates.

Research indicates that when youngsters assume adult responsibilities, either by choice or by necessity, they tend to be at greater risk of not succeeding in school. According to one study, 31% of the female dropouts in 1980 gave marriage as a reason for leaving school, while 23% said they were pregnant (U.S. Department of Education, 1986). Working a regular job is another type of adult responsibility which places some students at risk. Research indicates that while those who work only a few hours per week are more likely to complete high school, students who work more than 20 hours per week are more likely to drop out than those who do not work at all (D'Amico, 1984).

In addition, many at-risk children come from families whose life patterns have been affected by "abuse" of the human condition. While the effects of chemical abuse, neglect, and physical abuse are often obvious, the extent of these problems has not as yet been well documented. Although research in this area is still needed, we can already be sure that problems of abuse will reveal new implications for public policy.

Finally, and perhaps because of these other demographic, socioeconomic, and personal factors, at-risk students tend to have low self-esteem. This low self-esteem, manifested in a belief that the individual is without power to control his own destiny, severely compounds the difficulty of intervening with the at-risk student.

No single factor guarantees school failure, and many children with the characteristics associated with dropping out actually succeed in school and in life. The problem of at-risk children, then, is complex. It is not related to single causes, but, rather, to what Mann (1986) describes as the "nesting of antecedent problems."

An example of this "nesting" is the interactive impact of race and poverty. Both minority students and students from low-income households are over-represented among those who drop out of school. As if this were not enough, however, one finds that minority children more often live in poor households than do majority children. Thus, substantial numbers of urban school children today are characterized by not just one at-risk factor, but by several of those factors acting together to influence their life experiences.

In 1983, 40% of minority children in America were living in poverty, as compared with only 14% of non-minority children. Fifty percent of the children who live in homes headed by single females are living in poverty while only 12% of the children who live in households with males present live in similar poverty (Hodgkinson, 1985).

Although understanding the results of the research about at-risk student characteristics can contribute important insights into the challenge facing education today, it is important not to allow those results to over-simplify the problem. To do so would be not only inaccurate, but also dangerous.

Language—how we use words—is an important tool for leadership. The power that is implied by words is a part of Western philosophy that each of us should think about. In the book of Genesis, God gave Adam the power to name animals. To know the name of a creature, according to the Western tradition, is to understand its inner nature and to control it. Because this is true, it is important for educators to exercise caution in how we use the language related to student characteristics. There is a danger that we may mislead ourselves into believing that because we can name the characteristics of the at-risk student, we, therefore, understand the problem. There is an even greater danger that because we know the characteristics we believe that students with them are automatically doomed to failure and all attempts at intervention are hopeless.

It is human nature to confuse association with causation. The characteristics of at-risk students identified by the research can be demonstrated to be *associated* with school failure, but it cannot be necessarily demonstrated that they *cause* failure. Significant numbers of children with characteristics that place them at risk are able to "beat the odds" and will go on to succeed in school, have jobs, and be good citizens who contribute to our society.

The test, then, is not in how well we study the characteristics of at-risk students, but in how well we meet those young people's needs. The extent to which American public education is able to successfully respond to students at risk in the 1990s may well be the ultimate test of our greatness. For if there is any greatness in an educational system, or in the society which it represents, that greatness is reflected in how we treat the least of those among us.

The critical questions thus become

1. How can educational delivery systems be transformed so as to rebuild and revitalize the educational context that children, including those at risk, require for their effective functioning and growth?

2. Can new and emerging technologies be applied to the delivery of instruction and the management of learning in order to use adults in the classroom more effectively?

3. Can new methods of collaboration between home and school be identified so that more children and their families develop more constructive values toward educational opportunity?

4. Can transformed public policy be developed among all those in the community concerned with services to ensure a sense of collective accountability for children?

The primary problem is not one of ends, but of means. We as a society have yet to make a strong comprehensive national commitment to children and to providing the comprehensive support systems needed by children at risk.

Together, all those concerned with our society's future need to go beyond listing the characteristics of students at risk. Whether we are educators, human service providers, business persons, or parents, we must look behind the complex set of characteristics to identify the needs that at-risk children bring with them to school. Then, together, we must plan responses to those needs.

Because the needs are great, no one group can be expected to respond alone. Partnerships and collaborations must be the order of the day. Only by focusing our resources and our wills, working together and applying the best new technologies will the needs of America's urban children be met; and only if the needs are met will tomorrow's society be strong and truly humane.

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Technology and Students at Risk

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Good morning, ladies and gentlemen. It's an enormous pleasure to join you today, for a variety of reasons. In the first place, it's a joy to be a part of celebrating AIT's 25th birthday. Having served for five years as a member of the Board of Directors, I'm familiar with the outstanding record of AIT. As a consequence, it comes as no surprise to me that this birthday party celebrating the past is in fact a commitment to the future.

I want to thank Ed Cohen, Steve Kaagan, and the Board of Directors of AIT for taking the opportunity to focus this time together, with such an outstanding representation from the states and the provinces, on what I think is the single most important set of kids in the United States—those that we have come to generically refer to as "at-risk" kids. Whether or not this nation continues to succeed in this grand experiment called democracy, I think, is going to depend in large part on whether or not we find the way to translate a record of extraordinary success over the course of the past couple of hundred years into success for a group of kids that we have generally failed miserably in the schools during that same period of time.

It is also appropriate, I think, that AIT should place our discussion within the context of technology. I hope we succeed, through our work here and when we return home, in our mission to find ways to apply intelligently and imaginatively these relatively new tools to help address an old problem, which has, as I say, long eluded solutions—meeting the needs of students at risk of school failure. And please understand that it's not an accident that I usually refer to "our success" with those kids instead of to "their success" or to "their failure." Too often we ascribe to them the burden, the responsibility, of not having succeeded. And surely, there is responsibility there, but we can't shirk ours. It seems to me a very institutional thing to do. Indeed, as you heard yesterday in the comments of Bud Hodgkinson and Dick Green, we are on the edge of a situation in which for the first time in history, the victim of failure, whoever's failure, is not the victim alone. Historically, we've had that luxury. Historically, we've had enough kids that we can throw some away; it hasn't hurt anyone in the process except the individual. Historically, only the victim was the victim. We are now on the edge of a time in history when it's not going to be just the victim who's the victim—you and I will share that burden as well.

But the lens or prism through which I'm asked to focus on technology and the at-risk youth is that of the school. Against the backdrop of deep societal pathology, as painted by Messieurs Hodgkinson and Green, one could despair and conclude that solutions to the problems do not exist. That may or may not be so. I think the jury is still out. As we look toward a productive work force and an informed citizenry in the year 2000, it's not yet clear whether we will have the national resolve and the strength of character to meet the challenges that lie in front of us. We have the tradition. We have the potential resources. We have the successful example of our predecessors, of educators, elected officials and other policymakers, over the decades. Whether we have the imagination and will to do the job remains to be determined.

What is clear, however, is that if the at-risk young people of the nation are to be reached, if they are to be permitted into the mainstream of our life together, although many are going to be called on to help– families, businesses, human service agencies, religious institutions, law enforcement agencies and others– the public schools are going to be at the center of any successful strategy. And included in the schools' vital role is the use of technology to help us succeed where we previously have failed.

Much has been said here and before about the definition of "at-riskness." In relation to that issue, let me simply say that my focus today relates primarily to three groups of youngsters: Those who are poor, among whom minorities are disproportionately represented; disabled children, generally within the meaning of P.L. 94-142; and, limited English-proficient children, whose existence we are only recently acknowledging in any important way. I recognize that there are others who are at risk, such as those who use drugs and alcohol and youngsters who contemplate suicide and others. Those young people, are not less important; they are just beyond the thrust of my remarks today.

Before turning to the direct utility of technology and responding to the educational needs of at-risk children, I also want to offer a brief observation on one other matter specifically related. That is to recognize that we live in the age of information. Success or failure for all of us depends increasingly on our manipulation of information, its receipt, its generation, our ability to relate diverse bits of information. Information, of course, has become so central to our existence that it has even come to be regarded as a commodity. AT&T, IBM, and other giants of industry sell it and they buy it and they enable others to do likewise. On the basis of such commodity trading, a significant portion of our economy rests. It's also central within our wide-reaching and expanding data basis. Scientific and technical information is, of course, crucial to our national security, and in the last generation information has come more and more to be considered as necessary an element of production as land, labor, and capital. Not only is it a product, but our very ability to function effectively as citizens, as consumers, even as political participants, depends on our access to and understanding of information. Relationships to government are more complex, whether in applying for AFDC payments or filling out the new W-4 forms; the need to evaluate and make more sophisticated choices is a daily reality. Even one's ability to comprehend and act on individual rights and responsibilities has been made more difficult by the explosion of information technology has brought about and which technology now, at least in part, controls.

And thus, the existence of technology and the exponential growth of information, is part of what leads us to examine technology's usefulness in helping meet the educational needs of at-risk students. In fact, there are numerous ways technology, and I speak most often of the computer, can assist. There are generic contributions of computer technology which are not limited to any particular application. One might fairly summarize those generic characteristics by saying the computer empowers the student. The computer motivates; it is nonjudgmental; it will inform a student of success or failure without saying by word or deed that he or she is good or bad. The computer individualizes learning, permitting mastery at the student's own pace. In most instances, the learner has far more autonomy than in many other classroom, teacher-directed settings. The computer gives immediate feedback. And good software gives the computer the added potential of being remarkably imaginative. Such generic qualities cut across computer technology, allowing the learner at least the impression, and often the reality, of being in charge. This is the quality missing in the lives of many students, especially those who are at risk, due to an environmental, physical, mental, or language disability.

Having summarized the generic contributions of learning through technology, let me make two observations about technology learning. We do not need to teach very many computer literacy courses—translate that to "keyboard skills"—nor do we need to teach programming skills to the mass of students. For a time, both were what too many meant when the clarion call for technology in the classroom was sounded as it was following *A Nation at Risk*. In one sense, I suppose it was not surprising. With the dearth of good software, there were not many alternatives. Happily, though, software still is not of the necessary quality or quantity, fewer school people are running whole schools of kids through eight weeks of familiarity with the keyboard and attached monitor. It is increasingly recognized that most people will use the computer the way they use the telephone, the television, and the automobile—without being able either to build one or to fix one, they can accomplish other objectives.

Let's turn then to the more specific contributions that computers can make. First, it is clear that the basic skills of students can be enhanced. In a presentation to the U.S. Senate Committee on Labor and Human Resources in January, Robert Taggert, relying on work done by himself, Gordon Berlin, and Andrew Green, identified ten elements that research prescribes to teach basic skills effectively. They include individualized instruction, competency-based open entry/open exit approaches, use of multiple media and methods, self-directed learning, frequent feedback and positive reinforcement, accountability of teachers and learners, efficient management to maximize time on task, individual attention and one-on-one instruction, supportive services, and linkages to work training and other activities. Computers clearly must play a central role in such an effort.

Taggert also notes that there are models presently working in a wide array of settings. One in which he has particular confidence is the *Comprehensive Competencies Program*. It is in place in 200 secondary and vocational schools, colleges, community-based organizations, correctional facilities, job-training programs, union halls, and private sector work sites in thirty-five states and across Canada. He notes that the CCP learning centers have been described as the high-tech equivalents of traditional one-room schoolhouses. While the data on CCP is very persuasive, I don't stand here as a salesperson for CCP. I do say to you that there is a great deal of data which to my satisfaction demonstrates that we have the means and the know-how to deal with the basic skills of most, if not all, at-risk teenagers or adults in this nation.

At a different level, still concrete and still in the basic skills arena, I direct your attention to IBM's *Writing to Read* program. I understand from feedback in the last twelve hours that I could just as well direct your attention to the presentation made by the people from Vanderbilt yesterday. There could be a whole series of other focuses for that kind of activity. Stated simply, programs like *Writing to Read* work. The Educational Testing Service, for example, tells us that *Writing to Read* works. Children read better and they write better. The program works any way you cut it in the population, whether the kids be black, white, male, female, poor, or rich. It even works with five- and six-year-olds. Indeed in some few cases where poor children are involved, such as in North Carolina, the results are quite dramatic. Perhaps most important, it begins to move us from the realm of rote learning over into the realm of thinking, because it emphasizes writing—a theme to which I will return.

Finally, on the basic skills front, I direct your attention to the potential contribution made by authoring systems, such as the one developed at Johns Hopkins University. This multi-sensory authoring system is designed especially for use with disabled students at the readiness level for reading and mathematics. It permits teacher software creation, useful with particular children in particular settings. My point in identifying the Hopkins Authoring System, *Comprehensive Competencies, Writing to Read*, and in reminding you of the terrific presentation from Vanderbilt yesterday, is not to say that these are the only approaches to using technology to enhance basic skills. They are not. They are not necessarily even the best approaches. I simply wish to emphasize that whether one wants technology-based strategies for youngsters who are older or for those who are in kindergarten, or if one wants to design one's own, the technology is available and it works.

At the same time, we don't want to fall into the all too typical trap of thinking of technology only in the basic skills mode, much less the drill-and-practice mode. This is not to put drill-and-practice down as we so often do. It's simply to say that we should not focus on it exclusively. Should we do so, we would be limiting our uses of technology just as we did, until recently, by focusing only on teaching keyboard skills and programming. We need to think increasingly of computers as tools to enable the mass of students, including at-risk students, to think critically or analytically to solve problems, to draw inferences. We've long been successful in providing environments in which some students learn to think, but never in the history of humankind, have we succeeded in having the skills of critical thought become normative.

Moreover, never before has it been economically so necessary that we achieve that goal. And I turn, as Stephen Kaagan did on Sunday night, and as Dick Green did yesterday, to the Carnegie Forum, which in its report argued persuasively that we cannot compete in the international marketplace by trying to work cheaper than others. If we wish to maintain or enhance our standards of living, we must work smarter. And smarter means that the workforce we are presently educating must be able to think. That is to say, we must do something within that institution called school that has never before been done. We've not even really approached it. It means that we have to take a whole cohort of kids, including those kids that we traditionally and historically have failed, and succeed with them, not just in adding and subtracting and multiplying and dividing and deciphering or decoding language at its most simple level, but in thinking. We have to do what has to be considered as a breakthrough: That is, we have to reach that level of instruction at which the teaching of thinking skills becomes a normative matter for all kids.

The computer can help teach thinking skills. Word processing is a particularly good example. It assists writing, and writing, a skill that schools have at least pretended to teach on a mass basis, is the skill perhaps most closely connected to thinking. Because it helps students overcome some of the mechanical impediments to writing, word processing can help connect writing even more closely to thinking. It can solve problems of penmanship, from which some of us suffer. We find that with word processors students will write longer, more complex thoughts and sentences. They will revise, they will edit, and thus find better ways to say what they are thinking. Even the barriers of spelling and punctuation can be reduced. I'm not suggesting that we eliminate attention to the mechanics of good, written expression, but I am saying that we have the means to place those mechanics in the appropriate relationship to good thinking, good writing. Such a capacity is a particular advantage to many who are disabled or at risk in other ways.

There are, of course, other ways technology can contribute to thinking. Simulation is one. Think for a moment of the number of permutations of a science experiment that would be possible with a computer, but would not be possible in a science laboratory using expensive, consumable supplies. In a mathematics class, consider plotting a graph with the hundreds of points possible with a computer rather than the handful that are available if it is necessary to calculate them manually. There are many more examples of the ways technology can enhance students' thinking abilities. The challenge (to which I will return later) is to assure access to such liberating power to the poor student, to the limited English-proficient student, as well as to the wealthy or suburban student.

To shift to still another perspective: technology for disabled students can make the difference between a life of dependency—of existence under the proverbial staircase—and a life in the mainstream of competitive employment, with the family, a social existence and all the good things to which human beings aspire. Our State Department of Education and those elsewhere have identified a whole series of uses. Many who are hearing impaired benefit from word processor programs. A visual display and a voice output can be used to assist the deaf student in monitoring his or her speech output. Major applications for technology with blind or vision impaired students are generating large print on a screen, printing braille and converting printed text to speech output. Those who are having difficulty in speaking or writing are assisted by synthetic speech output and word processing with adaptive keyboards, which, for example, can even help with taking notes in school. Young people with specific learning disabilities frequently have significant difficulty in writing or spelling or organizing their thoughts or time. Remembering, organizing, editing, spelling can all be assisted with word processing. And, of course, students who are temporarily or permanently homebound can "keep up" through the magic of electronics.

In fact, the sheer link with the so-called normal world can make a world of difference. In one of our local area network pilot schools in Maryland, the school decided not to use the laboratory of thirty machines in a single room. Instead, they placed six machines in each of five areas of the school—mathematics and science, social studies, English—and six more in an area far down at the end of a corridor where not very many people went each day, in the special education section of the school. And for the first time, according to the testimony of the special ed teacher, that electronic connection to what those disabled children think of as the real world has made a world of difference. Simple things, not obvious immediately to you and me.

There are increasing sources of support for and information about the ways that technology can help the disabled. I am most familiar with two of those. One is the National Christina Foundation, which is presently at work with the Maryland State Department of Education and our twenty-four school systems. The chairman of Christina is a New York businessman who, not surprisingly, has a disabled daughter who was assisted by an eight-bit machine. He recognized that even though eight-bit machines are en route to corporate obsolescence, they have years of life left for many school applications. To demonstrate the potential uses for disabled youngsters, he has given us 2500 Apple PCs.

He and I believe that within ten years, corporate America will cease to use between eight and ten million eight-bit machines. We're in the process of methodically identifying the uses to which they can be put with a whole series of youngsters. Just as methodically, we intend to make that information available across the nation and internationally. The Christina initiative is one within the framework of the National Center for Technology in Human Disabilities, which Johns Hopkins University and our State Department of Education established last fall. Ours is an unusual collaboration of people in both the private and public sectors, and it has brought together thirteen different projects worth over three million dollars in the technology-disabled arena. Those projects involve youngsters from birth to age twenty-one, adults in vocational rehabilitation, youth and adults who are severely handicapped; they also involve outreach programs beyond the nation's borders, particularly in Latin America and the People's Republic of China.

Still another segment of our population that is at risk are those who speak limited English. Between 1978 and 1982, the overall nine- to fourteen-year-old student population declined by 6.2%. The limited English-proficient counterparts increased by 10.3%. Another way of putting the numbers in perspective is to note that while Spanish is the language most often spoken by these youngsters, as many of you know, there are more than a hundred language subsets spoken by public school students. In some states those hundred are spoken within a single school system, as they are in two of my own. This diversity of languages presents a major challenge, and again it involves a group of kids that we can no longer afford to fail.

Computers can sometimes provide instruction when no satisfactory alternative is available. CAI can speed up certain learning. It provides the greatest improvement for those students with the lowest achievement. Motivation is enhanced. Patience as you know is the hallmark of the computer. Interacting devices provide students with a sense of control. Students can fail without embarrassment and all of those qualities can be helpful in reaching the LEP student. According to a very good March (1987) Congressional Office of Technology Assessment Report (which I commend to you if you've not seen it) there is a whole series of successful uses with LEP students. For example, Seattle reports increased achievement with Vietnamese, Cambodian, and Laotian students using bilingual software developed for teaching U.S. history and reading comprehension. In San Diego, software in Spanish has proven useful. We already know that word processing packages and other devices used to enhance writing skills can be particularly useful. Add to that the availability of low-cost chips that add dual-language character generation, and thereby make it possible to write in Spanish and English at the same time. This can be a potentially powerful tool.

In addition to CAI, there are other computer applications that can help in the absence of teachers. I should hasten to add one caveat, which is very important to keep in mind throughout, although many people apparently do not: that is, that technology will not and should not be seen as some sort of widespread substitute for good, well-trained teachers. The essential qualities of a good teacher simply cannot, in my view, be replaced by machines. But machines can be useful when teachers are absent or scarce. The potential of distance learning, for example, is being explored by Utah, among others. Interactive videodiscs can be used to good advantage since they can take at least a portion of a sometimes scarce commodity, good teaching, and spread it around. Other potentially good contributions include digitized speech and audio devices. These can include native language speech output as part of an instructional program that is managed through the microcomputer. Also, dual audio tracks on videodiscs can be helpful as they permit instruction of any subject in English and in the native language.

These thoughts lead me to pause to make an obvious observation, an observation especially appropriate in the context of the conference sponsored by AIT. While most of my focus is on the computer, there are clearly other technologies, technologies with more than one component which can help with different objectives at different times. Straight video instructional television is one. We use it extensively in Maryland and with a variety of audiences related to our topic here. Our most recent national award-winner is *Constanzia's Choice*, directed to migrant youngsters. The message is a drop-out-prevention one. Another series of a different variety is the multiple segment series we developed to train special education teachers in kindergarten through the grade twelve. The series is now used in more than thirty states and is presently being dubbed into Chinese for use in the People's Republic. Still a third is a parent education series starring Greg Morris. The targeted audience is the teenage potential parent.

I've already touched on another basic way to use technology—distance learning. At present, Utah, Texas, and Oklahoma are the big producers, and the benefits for wide-open, sparsely settled spaces are obvious. The fifty schools, for example, receiving German I from Oklahoma State University simply would not have it otherwise. But distance learning is not only applicable in such settings. We use it via cable rather than satellite in densely-populated, central Maryland so that students in diverse high schools have first-rate courses not otherwise possible without the prohibitively high cost of both personnel and transportation. Again the issue for us is how to give poor school systems, where poor students are concentrated, the advantage of those initiatives that enhance the learning opportunities of at-risk students.

I want to turn for a few minutes from the direct way in which schools can be assisted in meeting their instructional responsibilities via technology to at-risk children and youth, to a different but equally powerful contribution of technology. To summarize the point I want to make, technology can produce, manage, and assist in the analysis of information about the students and their performance. This information can help in planning school system, school, and student instructional programs. It can also help generate resources from legislative bodies who are sometimes skeptical of needs but still insist on accountability. Computers can help organize the specific data for which they look. There are at least five ways that one can think about contributions in this arena.

First, student data bases, demographically organized, can produce powerful, policy-relevant information unattainable in any other practical way. Let me illustrate in a national context. For the first time in the nation's history there is some openness to developing state comparable data about student performance. The two key actors are the Council of Chief State School Officers and the U.S. Department of Education. About three years ago, after much study and debate and with Steve Kaagan's notable leadership, the Council of Chief State School Officers decided (on a 22-21 vote) to break tradition and provide leadership in this area by launching its National Assessment Center Project. (I might add that a year later the vote was 41-3—we had converts. There's a great turnover among the Chief State School Officers.)

The first significant contribution of the project was the decision itself and the cooperative effort it signified. Together, the states in this country are responsible for the governance of education for 40 million children in 16,000 school systems; the affirmative engagement of each state's educational structure is therefore, crucial in collecting data, and the Chiefs' decision opened the way for that engagement. One important contribution of the effort would be data which could be legitimately compared between states. If state-by-state data collection needs the Chiefs for access, it needs the active commitment of the federal government to provide the funding, and the second key actor in the effort is the U.S. Department of Education. Happily, Secretary Bennett says he is supportive and there are some signs of movement. As most of you know, the Governor Lamar Alexander/Tom James Report, issued last year, calls for a significant expansion of NAEP's state-by-state testing with funding by the federal government.

If we all continue the effort, and, most crucially, if we include proper demographic analysis of wealth, race, gender, parental education as well as the analysis of state school system resources, we will soon be able to know what we are doing and where and how we should do things differently and more effectively. For example, if I know, based on comparable data, that another state, or better yet, a school system in another state is producing better results than we in Maryland are with impoverished, Spanish fifteen-year-olds, the potential for positive change is substantial. Under these circumstances, change would occur, either because we decide to do the right thing (which I like to think happens once in a while) or because the front pages of the newspaper have forced us to respond. Either way, the kids will be the winners.

As a final word on that notion, states need not necessarily wait for the nation to generate student data concerning performance-sensitive indicators analyzed within appropriate demographic cells. Most states will have the breadth of students to do the very same thing internally. It will not be easy. There will be political risks. Deciding which indicators and population-profile characteristics to use is a complex task. Comparisons will generate controversy. But the means of generation, collection, and analysis of data are at hand, and if we have the courage and will to commit the necessary resources, such knowledge will surely enrich a state's ability to serve its students, especially its at-risk students.

A second way to use technology to produce, use, or manage information to help at-risk youths is in tracking those youths on a national, state, or school system basis. The most outstanding example of this that I know of is the migrant tracking system through which an individual student's progress and needs can be followed. This tracking can greatly facilitate instructional program planning for that student as he or she moves, for example, from Florida to Texas to Maryland. Similarly, sophisticated mechanisms capable of tracking the large numbers of students within our cities who move, in many instances several times per year, could be very helpful.

A third and related example would be the tracking of those young people who, for any number of reasons, are in a series of institutions, foster homes, or other settings. Designed properly, a program could track such youngsters and thus respond to them with relative ease and some measure of coherence.

A fourth use for technology is the identification of indicators of "at-riskness." Poor grades, truancy, persistent tardiness, behavioral problems, the need for repeated disciplinary measures—alone or in concert, these factors could indicate a threshold of "at-riskness" and call special attention to students about to cross that threshold.

We as educators care deeply about students and want very much for them to succeed, but often our responsibilities are so great that we cannot always know when a student is in trouble. Technology can help solve that problem. It can make a host of administrative and teaching duties—tracking student progress, keeping records, producing reports — more routine, thus freeing time for more instructionally related activities. For example, technology can help greatly in organizing and tracking learning objectives for individual students, related instructional strategies, class lesson plans that account for individual attention, and evaluative data that can be cumulative and cumulatively analyzed in a way that no individual can do it on his own. One way we in Maryland effectively employ technology for disabled children is in meeting our requirement that their IEPs each year affirmatively account for the 232 competencies in our K-12 competency-based program in reading, writing, math, world of work, citizenship, fine arts, and survival skills. It's one thing to establish standards and to raise expectations, but quite another to actually help kids achieve them. These efforts related to their IEPs have contributed to significant achievement gains by disabled youngsters on the required graduation competency tests.

I turn to the final element in the school perspective on technology and at-risk youth—several issues requiring attention if technology is to fulfill its promise in fact, not just in theory. In the interest of time, I will touch briefly on four and treat two others more fully. First, good and adequate teacher training is crucial. It is as important as anything else we can talk about. I will not discuss it in detail because I assume that Marc Tucker will touch on it in his presentation. We are in pretty good shape with hardware. We are not in quite as good shape with software, to which I will return, but we are okay. But in both pre-service and in-service staff development we consistently fall short. And yet, in the final analysis, good teacher training is the key to the successful use of technology.

Second, we need systematically to disseminate information about the major concerns of this conference. Third, we need to increase the evaluation and research on technology's impact on at-risk youth. Fourth, school systems and states should be far more purposeful in their objectives and strategies for harnessing technology to help students at risk.

There are two final, critical factors. The first is the issue of access. The poor are disproportionately represented among at-risk youth. It is hardly profound to note that poor students are more concentrated in less wealthy school systems. Impoverished school systems do not have the necessary resources, obviously, that are available to the rich. I use Maryland to illustrate, not because the inequities there are particularly bad, but because I happen to know the numbers. The wealthiest system spends $2,000 more per child than the poorest. That means that a typical classroom of thirty children has

$60,000 more in resources than the other system, simply by the accident of birth or residence of its students. You can guess which classroom has more of everything, including access to technology.

Solutions to these problems of gross inequity, if they are to be found, will contain at least two elements. The major one is that the public, including corporate America, educational leaders, and elected officials, recognize the need, either for reasons of human decency or, more likely, economic necessity, and demonstrate the resolve, intelligence, and courage required to provide the resources. The other part of the solution likely will require at least some ventures in creative financing, ventures which will, I expect, involve the private sector to some extent.

Let me illustrate this with one approach we are exploring in our own state: As many of you know, we have been engaged in developing some new approaches to the delivery of technology that involve networks. A typical network would include a mini computer in a school connected to thirty terminals, either together in a laboratory setting, or dispersed throughout a building. We use them for administrative purposes, for math and reading drill and practice, and for word processing for disabled kids. We use them in science and social studies, and in a host of other contexts. In addition, we've begun, on an experimental basis, to transmit software through the airwaves via a television signal to be received and stored for use in pilot schools. Using that basic hardware construct, accounting for minimally appropriate staff development—and I emphasize minimally—for supervision, for appropriate software acquisition with the objective of providing one thirty terminal/one mini, for every 300 students, that is a 1 to 10 hardware ratio, we face a cost in our little state of between 110 million and 120 million dollars.

For us, that is a lot of money, a sum not likely to be made available through state and local appropriations. We are thus exploring the establishment of the Maryland Instructional Resource Center, or MIRC. MIRC would be a collaborative effort, emphasizing public and private partnerships and commercial opportunities. Private concerns, for example, could either purchase the hardware, retain ownership, give it to the schools for daytime use, and market it on nonschool time or they could purchase excess capacity from a school district or consortium for similar purposes.

Potential profits in either case would be used in part to help underwrite the school district's use of computers in other schools. Moreover, we hope to involve a major communications company that would provide remote access to school sites, or even multiple seriation access, should the closest sites be at capacity use. That would permit home remote access. That would potentially broaden the private and profitable market considerably. Frankly, I don't know whether those plans will work. Our present plans will probably go through several additional generations of thought in the next several months. My point is that resources are a serious problem. Solutions will not be found in traditional ways. The promise of technology will likely fail without new departures, without new partners. And, it's up to you, to me, to create those new ways and to find the new partners.

Another comment or two about access. Too often at-risk youngsters are treated in schools only to drill-and-practice opportunities, while others are engaged in thinking skill activities. That is a mistake. It is also an issue of access. At other times computers are used only in courses with prerequisites in math and science. Too often the at-risk child will not have, for example, the algebra prerequisite. At-risk youth will not have as much nonclass computer time. He or she is less likely to have a computer at home than a wealthier counterpart, and more likely to be in a school, where for reasons of resources, the school is shut down in mid-afternoon. There are multiple ways schools must question and consider the access issue, but it is a threshold question.

And, finally, a word about software. It's better, you know that, but it's not particularly good. The single biggest reason it has not gotten better faster is that not very many people have yet discovered a way to make money producing educational software. The problem is compounded for subsets of youngsters, like LEP students, where the market for some items would be even thinner. If there is an answer to the several software issues, it lies in part in creating market power. We need a consortium, sufficiently broad-based and cohesive, so as to produce sufficient users to enable us to drive unit costs down, shape content and determine development priorities in line with school/student needs and have the power to also say we have some important, special needs like those of LEP students. Happily, we have the embryo of such an effort in the software consortium network to which eighteen states and four Canadian provinces belong at this point. Every state and every province should be a member and thereby provide the kind of substantial market power necessary to accomplish our objectives for our kids in contrast to leaving those determinations in the private sector.

The challenges that we face are extraordinary. We have a moment in time in which there is opportunity. There is more activity on this front than in at least a generation. As I wander about this country, I note that the National Governors' Association, has made this set of issues with at-risk kids its focus. The Education Commission of the States, the Council of Chief State School Officers, the National Alliance of Business (in a renewed and vigorous effort)— all have made these issues their focus. The Committee on Economic Development, which is in fact a business group, has issued a second draft report on at-risk students and will issue the final report in the fall. Not, I say, all of that activity for reasons of altruism— that's not the motivation. It goes back instead to the fact that the chickens are about to come home to roost, not just on the victim's doorstep but on the doorstep of us all. That's the motivation.

But never mind the motivation, there is opportunity. It is entirely appropriate that AIT should have had this conference at this moment as a piece of a growing, swelling concentration of attention focused on this set of issues. I don't know whether the critical mass will develop in a way that will permit us to make the kind of commitment as a nation or within a state to actually succeed with these kids, but now is the time to try. And as I say, the challenges we face are extraordinary, but the stakes are high. It's going to require commitment, it's going to require imagination, will, courage, resources— and I might say, in that order.

James Agee once said, "With the birth of each child, the potential of the human race is reborn." As leaders in the development of educational public policy, we in our several roles that bring us together have the opportunity (and I think the responsibility) to help translate that potential into reality, not just for some kids, but for all kids— including kids who are at risk. Technology can help us do that. Thank you very much.

Information Technology and the Schools: A Personal Perspective

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It's a real privilege to be here today. This is, I think, a very important occasion. I'm going to speak to you from a very personal perspective. Like many of yours, my life has been intertwined with issues of educational technology for a long time. In 1962, I left the Yale Graduate School of Drama, where I was doing graduate work, and went to Boston to join the staff of the WGBH Educational Foundation, Channel Two, in Boston. After three years there doing production work in what we now call public television, in what we used to call educational television, I became the assistant director of the education division of WGBH. In that role I was meant both to develop nonbroadcast applications of modern communications technology and to manage the instructional program of the agency. I told my boss when he hired me for that job that I knew little about television and nothing about education. And he said that was all right; I'd learn, and I did.

One of the first things that I did when I took that job on was to take a look at the literature on instructional television. Think back now, this was 1962, 1963. If you were to go back and look at that literature now I think you would find it eerily familiar. It was suffused with the rhetoric of possibility and the rhetoric of productivity. What do I mean by that? The people who were in Washington then testifying before the Congressional committees, urging them to invest millions in instructional television, were people who were profoundly impressed by the possibilities of the technology. They would go on, if permitted, for hours before Congressional committees, telling them glowingly about all the things that television, if unleashed, might do for the kids in our schools. I won't bother reminding you of that rhetoric. I suspect it comes easily to mind how you could bring before every school child in the United States the most famous people who have ever taught; how you could, with modern production values, make interesting what had formerly been dull; how you could bring to kids in rural areas and to poor kids in urban areas the fine education they had been deprived of for generations.

And along with the rhetoric of possibility there was the rhetoric of productivity. One of the major messages that those people, with the best will in the world, brought to the Congress was that technology, in this case instructional television, could bring to kids an education at least as good as that which they already received for a fraction of the cost. And when you put the whole message together what you got was a vision— a vision of kids learning what they had never been able to learn before at a cost lower than that which the system currently incurred. And many, many people, as you may recall, were profoundly impressed by the message. The Ford Foundation in particular spent tens of

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millions of dollars not only creating that message but getting it out to the entire country, and doing everything possible to get people to act on it.

Gradually a literature of education research grew around instructional television, and its message was simple: Kids learn as much through instructional television as they do through conventional instruction. But when some of us— in that instance, myself—went out to the schools we found a reality that was rather different from the vision that had been projected in those Congressional committee hearings. The reality was dull. The reality was head and shoulders shots of classroom teachers in front of cameras. And when you looked at the kids you got what you paid for— their eyes were as glazed over in front of the instructional television set as they were in front of their classroom teachers.

Then there was the reality of the dollars. What I really discovered at WGBH was that instructional television was a cash cow. At WGBH and at community stations across the country, the instructional television programs that the stations were pumping out, usually from the beginning of the day to the end, generated enough dollars for them to do much more with what really fascinated them—community programming for the public at night. That was the economic reality for the community television stations then.

What impressed me more than anything else, though, was going out and visiting schools. There I saw how untouched the lives of children were by the television sets that they were watching, and how teachers from one end of the country to the other took the opportunity that instructional television afforded them to go out and take a smoke, to relax a little bit in a very demanding day. Most often the instruction was very poorly integrated with the curriculum in those schools. It could hardly have been otherwise. You had one virtually inflexible medium, usually broadcast statewide, brought up against an almost infinite panoply of individual requirements and customs among students, classrooms, schools, and districts.

Apart from the fact that the technology for which so many people had so very different a vision left the lives of kids so untouched, and the lives of schools so unchanged, what was, I think, most profoundly discouraging to me was the way in which instructional television evolved with respect to the kids who are the central topic of this conference. It was clear, as the early sixties went on, that the states that were making the largest investment in instructional television were the states of the Deep South. That part of the message of the vision that got through was the research message. That was, in effect, that kids were not harmed by instructional television. That the quality of the result was no worse. This is not quite the language that was put forward but I believe it was an accurate rendition of the research.

The effect was no worse with these kids than with the control groups that were taught by their regular classroom teachers. That message got through to the Deep South. In effect, you could avoid reorganizing education in the districts, in the schools, and in the state. 'Separate but equal' was justified by science. In the process, the kids who received disproportionate shares of instructional television programming were condemned to a life of the mind which none of us would choose for them.

While I was carrying out my responsibilities by producing instructional television programs that could be the cash cow for what really mattered to the station, I was also trying very hard to find out what education was really, in fact, all about. I spent a good deal of my time in the city of Boston, in schools serving the poor—poor white kids, poor black kids. I attached myself to people like Ruth Batson, Paul Parks, and Mel King, leaders of the black community in Boston who cared desperately about the plight of the kids in that city. They showed me a different world than the world of possibility and the world of productivity that had been testified about in the United States Congress. They showed me a world of kids without hope. They showed me a world of parents out of touch with their schools and rejected by their schools. They showed me teachers who were confused, frustrated, and ultimately angry about their inability to reach these kids and about what seemed to them the kids' lack of motivation for learning.

It was a system where the problems that the kids brought to school had overwhelmed the school district. It was a world miles and miles and miles away from the vision of the technologists, and there was no conversation between the two worlds. There were people at Harvard, there were people at any number of other universities and public policy analysis centers, centers of national and international repute in education around Boston, discussing the problems of disadvantaged children, but there were precious few with their jackets off and their shirt sleeves rolled up trying to do something about them. And when they did arrive, what they typically arrived with was the "latest idea" for doing something for these people. Typically what they wanted to do for these people was what ever the latest innovation was, the latest thing that had grabbed them, including the use of technology.

The folks that I talked to in Boston were not interested in the latest innovations. What they were interested in was what was good enough for Newton. What they were interested in was what was good enough for Brookline. They didn't trust the folks coming down the pike with the new ideas; what they wanted to have was what was good enough for the well-to-do people in the rich suburbs who had choices.

I left WGBH and I left instructional television. The technological vision, it seemed to me, had little to do with reality, and I was interested in working on the realities. I spent the next six or seven years of my life trying very hard to see what could be done to organize the massive intellectual, financial, and institutional resources of the Boston area on behalf of poor kids both in the city and in the rural areas. It was a profoundly sobering experience. In the end, I thought very little had been done for those kids after what was probably the most massive organization of resources to meet their needs that this country had ever seen. In the end, the schools looked very much as they did at the beginning. The relationships between kids and teachers, between teachers and administrators, were much unchanged. The fundamental curriculum was, at the end, what it had been at the start. After billions of dollars of national effort, little, I thought, had changed.

And I was not alone in looking for explanations. In 1972, I happened to have the good fortune of being among a small group of people who were responsible for planning the new National Institute of Education. In the course of that planning we commissioned a paper from John Pinkus. John Pinkus was then director of education programs at the Rand Corporation. He was a development economist, someone who worries about how to help developing countries. We asked John what, according to a professional economist, characterized the behavior of innovative school systems, and what incentives motivated them to invent new and better ways of meeting the needs of kids. It was a very important question to me then, and I think a very important question to all of us right now.

Now again I'll ask you to think back to the late sixties and early seventies. The catch phrase then was "innovation." If it was innovation, it was good. If it was not innovation, it was stasis, and therefore bad. John's paper was about innovation, about the incentives that school districts have to do something better for their kids than what they have been doing in the past. John did not go out and do empirical research. Instead, he sat and stared at the wall and he wrote us a thinkpiece. Here's what it said: If you search through other areas of our national life for parallels to school systems, you find that they most closely resemble public utilities: electric companies, water companies, telephone companies. And why is this the case? Because those entities, like schools, are publicly funded monopolies designed to provide necessary services to everyone.

John thought about what the economic literature had to say about the incentives for innovation that operate on these economic institutions—and that literature was, by the way, enormous—and he compared them to the circumstances surrounding school districts. Although those circumstances are, he found, different from those of water companies, electric companies, and telephone companies in obvious respects, the similarities are instructive. John made a few observations by way of trying to explain an apparent contradiction. Here's what that was. School districts are faddish, and grab at every idea that comes down the pike, and just as soon as they grab hold of one they dump it in favor of another. And yet, at the very same time, many people were saying, and often the same people without realizing the contradiction, were saying school districts are impossible to change. "How," asked John, "could both statements be true?"

"School districts," he said, "have a very strong incentive to look modern; they are political institutions. What they sell, in effect, to those in their community, is the notion that they are up with the times, that they are modern, that they are doing all of the best things." It is equally important, he said, that schools not appear to be too experimental, because nobody wants people experimenting with their kids. Ideally, where schools want to be is in the position of saying "we are right up there, we are modern, we are right behind the leading districts, we have looked at what they've done, we have thrown away the things that haven't worked, we have taken only the ones that do work and we have grafted it on to our really solid educational system." That explains the faddishness, says John; that explains going after new, but still proven, ideas as fast as they come down the pike. School systems want to be in the position of saying to groups of parents, "We have considered the new ideas that you have just read about in the national magazines. We have looked at the evidence, and we have adopted the ones that appear to be worth adopting."

How do you explain the notion that districts never change? There is, John observed, only one class of innovations that districts will adopt easily—those that do not threaten the established structure of power, that do not threaten the conventions through which we do business, that do not threaten people's jobs. In the end, what we—not the school district people but those of us who affect and set policy—have constructed is a system whose first obligation is to protect itself, and in protecting itself it must protect jobs, increase revenue, and not do anything which destabilizes the system which it is responsible itself for administering.

What I just said about innovations and school systems may provide some clues as to why schools responded to instructional television the way they did. TV was high on the public's agenda. It was important to be modern, and modern meant having television sets in classrooms. And television was costless, at least in terms of what is most important to our systems, institutional change. Instructional television allowed school systems to get money they might not otherwise get. But as soon as you try to develop systems that would take advantage of the inherent possibilities for cost savings you cross the line. Neither teachers nor school administrators have strong incentives to improve productivity. In fact, the reverse is true.

If school district managers can show that they can do something that used to cost a hundred dollars for fifty what is going to happen to them? Their budgets are going to get reduced. There are not incentives for that. None at all. If you come forward with an idea that is going to take away teachers' jobs, there are not incentives for that. At least once a year you have to deal with teachers if you live in a collective bargaining state, the most central reality of the life of a school district manager. No way are you going to get involved in a fight to the finish over reducing the number of jobs in the district. The effective compromise is to put television sets in classrooms but not change the way actually educate kids at all, especially if it's going to take away teachers' jobs, or forced them to change the way they do their work, in ways that are uncomfortable for them.

There is one other point that I want to make in connection with John's remark and it is this: the world in which school people live is a world that tolerates incompetence world without end, but cannot tolerate trouble. What do I mean by that? The school board member or a school superintendent lives in fear of the newspaper reporting they have done something dreadful, committed an error which could incur the wrath of any powerful group in the community. The last thing in the world you want to do is to get blindsided, to have trouble you didn't anticipate and be unable to cope with it. That is how you lose your job. The way to avoid that is to bring all the reins of power back into you office. An effective reporting system and an effective control system are your best insurance against getting blindsided. Incompetence, however, is not a serious problem. We do not reward teachers, guidance counselors, curriculum supervisors, or school superintendents on the basis of the performance of the kids, or on the basis of their personal competence as it relates to the performance of the kids. There is no connection. None. If they can simply show that their district is doing no worse than other districts serving comparable populations, or better yet, comparable districts as you define them, there is not a problem with respect to competence. The serious problem is with respect to trouble.

In the late 1970s, having been largely uninterested in technology for the preceding fifteen years or so, I realized, as many others did, that the world of technology had greatly changed. What we meant by "technology" in the late 1970s was computing and communications technology. These struck me as totally different in their possibilities and potential than instructional television had ever been, or would likely be. I'll explain why in a bit. What struck me at the time, however, as I listened to the Congressional testimony that was then being given on the Hill by people who had been called to testify on federal policy with respect to computing and communication in the schools was a sense of déja vu, and it was eerie. The rhetoric was the same. It was the rhetoric of possibility and the rhetoric of productivity. All of the possibilities which you heard about just a moment ago and many more that you are well aware of, were laid before the Congress. Here is what computing and television communications could do if it were unleashed.

As you know, those possibilities are endless, and they are exciting, even revolutionary; and, just as had been the case with ITV years before, they captured the imagination of many people on the Hill and throughout the country. And again, the submessage was that the possibilities were not only exciting and endless, but the effect on school productivity could be enormous. Think of what these machines could do that teachers now do, and could do more effectively, at less cost. You could take the testimony delivered in the late seventies and early eighties in the Congress about these things, and take out the words computing and communication and put in the words instructional television and it would be largely unchanged.

I did not find that particularly reassuring, and once again I went out and visited the schools, and found the same reality. I found kids sitting in front of computer-based drill and practice programs who had the same glazed over eyes as those who had watched instructional television programs of the fifties and sixties. I found school districts as unlikely and as unwilling as they had been two decades earlier to make the major structural, personnel, financial, and curriculum changes that would be necessary to realize the potential of the available technology. The incentives that John Pinkus had talked about in 1972 were wholly unchanged. The incentives that people had to use computing technology in the schools were identical to the incentives they had had with respect to instructional television. The whole country was infatuated with computing technology, particularly with personal computers. And what was important to the public, especially to upper middle class families in suburban communities, was that their kids have access to computers.

The public had no more idea how those computers ought to be used in schools than they had had twenty years before with respect to instructional television. And the incentives on the school people were much the same, that is, to find ways to use computers that will disrupt the life of the school as little as possible, having as much computing available for public view as you can manage. There should be no mystery as to why we put together labs of computers, why we installed on those computers drill and practice software, why we took advantage of that handful of teachers who were very enthusiastic about personal computing, which for them meant programming, and put them to work and said go and do whatever it is you think right. The message to the rest of the teachers was that nothing had to change. They simply had to send their kids down to the lab for thirty or fifteen minutes a week for exposure to computers. And that exposure results in exactly what the ITV exposure had resulted in years before— little change in schools,and little change for the kids.

This is basically what all of the research shows. There are of course exceptions. About four or five years ago I visited a job corp camp in Maine. I was utterly fascinated. The kids that I sat down and talked to in the camp were making very impressive gains in basic skills. When I visited the places in which they actually did this I found the software dull and boring. But there was a difference. The kids in that job corps camp knew exactly what skills they had to master. They had a machine using Plato technology, which assessed the progress against those skills and told them how far they had gotten and what they had to do next. Unit by unit. And the kids had a choice: they could either use computer-based teaching material or use the workbooks. It did not take long to figure out that the material was the same, whether written or on the machine.

Here was a situation in which those kids who were motivated by computers could use them and those who were not did not need to. Their progress was about the same. But the most telling thing that happened when I sat down with those kids and asked them why they were devoting the kind of effort they were to making progress in this deadly dull environment. Their answer was very simple. After being in the job corps camp for less than a week, they found out that the kids who made it to the end got decent jobs. And almost nobody else they knew or had been friends with in the schools that had failed them was getting anywhere in life at all. The motivating factor was jobs. The technology could provide motivation to those who found themselves motivated by it; and, the highly structured program worked for those kids because they needed highly structured programs; but the primary motivation of the job corps camp was the opportunity for success in life. That more than anything else made it different from the schools they had attended earlier.

Perhaps the most impressive use of this technology for disadvantaged kids I have seen was at the Hennigan School in Boston. It was the beneficiary of a fairly large IBM grant, and the staff of Seymour Papert and his colleagues at MIT. It was an ordinary school in Boston, had a regularly assigned staff, and amazing things were going on there. It served very poor kids, both white and nonwhite. I'm tempted to describe it in detail, but I won't. I'll just give you the highlights. There were enough computers and, even more important, the staff was well enough trained to use those computers so that kids all over the school were writing— writing stuff that was interesting, that was vibrant, that meant something to them. They were illustrating their stories with animated pictures. They were sharing their experiences with one another. They were sharing their stories with each other. They were sharing their computing experiences with each other.

The school had a *Lego Logo* laboratory in which kids in third, fourth, fifth and sixth grade were actually learning what I can only describe as engineering skills. They were trying to build things out of Lego sets attached to computer-driven devices and sensing and motorizing devices. They were learning things about design, about some physical principles and about mathematics that stunned me. And I went to talk to the teacher of mathematics in that school, a black woman who had been there for many years, and whose recent experience with this technology had been transforming for her. She found kids coming out of the at *Lego* laboratory asking questions about mathematics— because they needed to know the answer in order to build something— which don't ordinarily come up until the middle of college. She went out and found answers to those questions because it really turned the kids on to mathematics. And with it she was able to teach kids from those backgrounds mathematics, some of it advanced, some not so advanced, some of it very basic, that she had been unable to teach since she had begun to teach years before. Those are the exceptions. The reality nationwide, I believe, is much as I described it a few minutes ago.

I want now to go on to another kind of reality, the economic reality that this country faces. It is in an economic context that we must look at not just technology but the general education challenge in this country. We face, in a way, a very simple problem. The schools of this country now exist in much the same form as they were designed in the 1920s and 1930s, only now they must meet a wholly different need. In the 1920s and 1930s this country was rapidly industrializing. It was becoming a smokestack economy on a scale the world had never seen before. What it needed were people with what we now think of as rudimentary skills to do very routine work in offices and in factories. Teaching these rudimentary skills to the numbers of people this country needed for the jobs was an extraordinary task at the time, because it required attaining a skill level among the population that no country on earth had ever achieved before. The victory that this country gained achieving it made it possible for us to become the leading economic power in the world.

The problem, however, now, is that we live in one integrated world economy. And the plain fact of the matter is, that there are millions of people, especially on the Pacific rim, who have the skills required to do that routine work in greater measure than do we, and, moreover, who are willing to work almost twice as many hours a year for one-tenth of the wages that we charge to do routine work. The message in that simple statement is fundamental. If this country is going to survive, if it is going to maintain its current standard of living—never mind improving it—we have to leave the routine work of the world to countries in which large numbers of people, the mass of people, are willing to work twice as many hours a year as we are for one-tenth the wages. That means that millions and millions of jobs requiring the basic skills but no more than that, will disappear.

What that dynamic is producing is a growing underclass. It used to be that a youth could drop out of high school in Detroit and go to work for the auto union and confidently expect, if he just stuck to his knitting, so to speak, that by his mid-forties he'd be earning a very good salary. The message for millions of American workers was that what they knew was not very important. All of that is coming to an end. It also used to be that if one got into a business at the bottom of the ladder and was willing to work hard, he could expect that he might even get to be company president someday. This is not true anymore. The bottom of the ladder is now rising out of sight. The bottom rung of the ladder requires certain skills just to justify the employer's investment—skills that an increasing number of kids in the United States simply do not have. And when they leave school without those skills, they become eligible to join the class of people who are permanently dependent on the rest of us who have decent jobs. That is where this country is right now. That is why we have a growing underclass in this country. We simply charge too much, in a single integrated world economy, for the work that people do who are capable only of doing routine work.

The implication is that we will succeed only if we produce a nation of kids who have the non-routine skills, the skills that David was referring to when he used the phrase "critical thinking." The routine skills alone are not going to hack it. The message for those we are calling in this conference "students at risk" is impossible to overstate. Those kids are at risk of becoming dependent for the rest of their lives, and the country is at risk of incurring a steady decline of national income. We could as a country try to compete on equal terms with South Korea and Taiwan. That is, we could employ masses of relatively unskilled people if they are willing to work twice as many hours a year at one-tenth the pay that this country now provides as the minimum wage. We could take this route, except that along this way lies economic disaster and social conflict of unimaginable proportions.

Our only solution is to set wholly new goals for our schools, goals far above what they now are. Most importantly, we must set much higher goals for the kids in that growing underclass, the kids we are at this conference calling "at risk." I will repeat to you what David said a moment ago. There is simply no way of producing kids who can think for a living unless they have teachers who think for a living. We are not going to have a nation of kids who write well unless their teachers can write well, unless their teachers have strong analytical skills, unless their teachers really understand the subjects that they are teaching, unless they are creative and imaginative. What we desperately need for kids who are at risk are teachers who would otherwise be professionals in our society. Technology will not meet that need. It is no substitute for teachers. We do not have, nor are we likely to have in our lifetimes, computers that will teach kids to read and write well or computers that will teach kids to be good problem solvers, to be original, creative thinkers. And that is precisely what we need.

If, however, we have those kinds of teachers I just described, the single greatest asset they could have to get their job done is computers. For me, computers are wholly different from instructional television in their potential to improve education because they are productivity tools. They can help meet the economic challenge of rapidly increasing the productivity of people in our society. That is, increasing the amount and quality of work that can be done in any given unit of time. Only two things are required: highly educated people and the most advanced technology available to help them work as efficiently as possible. That is the significance of technology.

Computer and communications technology enables people to do much more work and higher quality work than they could do without those machines. It enables people to write quickly, to write analytically, to organize their ideas, to bring to bear data on the work that they do, to organize their thoughts, to paint, construct, design, build, you name the task. To do those tasks faster, more creatively, at a higher level of quality than they could possibly do it without them. Computers are significant because they will, if we are successful, infuse every aspect of our lives and improve productivity radically in every line of work that people do. What is critically important is that the kids in our schools adopt technology as second nature. That they have the machines available to them and know how to use them in a productive way. Like the rest of the society, they must improve their capacity to write well—nimbly, analytically, creatively—to organize data, to ask the right questions, to get at the information they need and know how to use it when they have it, to make music, to draw pictures, to conduct laboratory experiments. The uses are endless.

The brilliant teachers in our society, I think, will have no trouble finding ways to use machines—correction, finding ways to help our *students* use machines that will make these students the most powerful people in the world—powerful not in the sense of overcoming others, but in developing their own potential. And that is precisely the task ahead of us. Teachers who are not themselves well educated will be totally incapable of using computing in this way. It is not a question of good teachers or computers. It is, in fact, the reverse. Only very good teachers will be able to use the machines in our schools the way they have to be used if our kids are going to reach the standards they have to reach. There is no parallel with instructional television. Instructional television is not the means by which our society is going to become more productive and competitive. Computers, however, most certainly are.

It is one thing to get up on a platform and lay out, in effect, what the potential of the machine is and how it might be combined with other resources, mainly very good teachers, to realize that potential; it is quite another to determine precisely what incentives the people in our schools—the school boards, superintendents, the curriculum supervisors, teachers, and others—will need to share in this vision and act on it. To get the kinds of teachers in the schools who will use technology to its fullest potential, and to keep them there, we have to redesign our schools. We have to redesign the institution.

Technology will be used well and wisely in the schools when the schools have been redesigned as performance-oriented institutions. We now manage our schools on design criteria, not performance criteria. When people ask for something to be built using design criteria, what they say is "I want you to make me a widget. I want the widget to be composed of the following parts: it has got to have a round piece, it has got to have a straight piece, and it has got to have six levers and five gears. Here's the drawing. You build the thing so it meets this design specification." If you are operating with engineers according to performance criteria, however, you go about it in a very different way. You say here are the performance standards I want this thing to meet. Here is the job that it has to be able to do. The closer you get to these performance standards the higher your rate of compensation for doing this job is going to be. And I don't care how you do it. It can have a round widget and six levers. It can have gears or no gears at all. It is entirely up to you how you meet these performance standards. Again and again, studies have shown that if you are able to use performance standards the quality is higher and the cost is lower. They not only allow and encourage innovation in the system, they also direct the innovation precisely where you want it to be directed—toward higher quality and lower cost. That is the advantage of using performance-oriented systems.

In education we do not use performance-oriented systems; we use design-oriented ones. We say to the folks in the school, here is the curriculum, here are the goals, here are the texts, here is how we want you to divide the school day up, here are the courses that you have to teach, here are the number of units you have to teach it in, and here is the scope of sequence of instruction. We provide the design standard. We essentially give teachers the blueprint. And what do we get out of that? We get a high cost, low quality system. What we need is a high quality, low cost system. We need to move toward a performance orientation. What would you do if we said what we are interested in is performance? You design a system from the state policy level that says, "Here are the performance goals for students. Here's what we mean by improved student performance. Here's how we're going to measure it. Furthermore, we are going to connect the rewards that you get, by which I mean salary and the resources available to the institution, to the progress that the kids make. The more progress, the greater the reward; the less progress, the less the reward; no progress at all or regression, you're out, we will get somebody else who can do the job." That is an entirely different public policy system.

Imagine the effects of such a system on the two things that are of interest at this meeting—at-risk students and technology. One state I know of is considering passing a piece of legislation, for which there is already considerable legislative support, which essentially says that if teachers in individual schools are able to make an across-the-board ten percent gain for the students in their schools, they will get a handsome bonus at the end of the year, not as individual teachers, but as a staff working together on behalf of all the kids in the school. If those kids maintain that gain in the following year, you get to keep your bonus in the following year. If they don't you won't. The only way you're going to get an additional bonus beyond that is if the kids display another ten percent gain, year to year, over what the kids in the same class level got the preceding year.

Another state is seriously considering, again with a good deal of legislative support, a proposal saying that schools—which in this instance means the parents, the teacher, and the principal—that decide they want to take responsibility for the progress of the kids in their schools will be given autonomy from the school district and substantial support from the state. In other words, the state and the district will stop telling them how to do their jobs. Instead the schools will set their own performance standards and, if they achieve them, they will continue to have that kind of independence. What do I mean by independence? The parents, the teachers, and the principal will together be able to determine what their goals are, what the curriculum is going to be, what texts are going to be used, and how the pro-rated allocation to that school is going to be spent. I don't mean the few hundred dollars discretionary funds, I mean the whole school budget. So you will get to decide what your staffing structure is going to be, what services you want to hire in from the district, what services you want to hire in from outside, what services you want to perform yourself, its all up to you, staffing structures, budget allocations, who gets hired, but you're responsible for the outcome. Wholly responsible for the outcome.

Now, imagine in the first of those two examples what the results might be for at-risk kids. There's every reason to believe that it is going to be a lot easier to make a ten percent across the board gain for poor kids than it is for rich kids in the well to do suburban communities. A ten-percent gain for the rich kids in the suburban communities is going to be very hard to come by. But a ten-percent gain for the kids in the inner city, if you really put your mind to it, is not going to be at all hard to come by. In fact the second ten-percent gain might be pretty easy to come by, too. We now have out in our schools a set of incentives for our best teachers to move as far away as possible from the kids who need their help most. District to district and within districts, that's what public policy is. Schools get money for identifying kids with problems but if they solve their problems the money gets taken away.

In the system I was just describing, the only thing that counts is the progress that the kids make. If that's your incentive, what are you going to do? You're going to get the most capable teachers you can get; you're going to push the teachers out who can't hack it because your pay depends upon their doing the job, not just you doing the job. And lastly, you're going to reach out to the parents; you're going to try to figure out what the kids problems really are, in school and out, because knowing something about all those things, and doing something is going to have an end product, mainly the improved performance of those kids. If that's what your pay depends upon, that's what you're going to do.

With respect to technology, its going to change the equation entirely. If you figure out that the way to get improved kid performance is by using technology, and if that's going to cost you some positions, if it's going to cost you some time, if its going to mean rearranging the budget or even reorganizing the school itself, you're going to do it, and you're going to use the technology in the way that's going to get the highest quality for the lowest possible cost. Those are the incentives that have been missing all these years. That's why private industry uses the technology the way they do. They have very strong incentives to cut cost and improve quality, and if hardheaded people come to them and say this is how you're going to improve the bottom line, that argument is going to sell. There is no bottom line in our school system. Public policy with respect to the school districts as a whole says you're going to get more resources, the bigger your district is, the greater the enrollment is, the longer you keep kids in the seat, and the higher the unit cost is of instruction. That's what pays. In that formula there is no incentive at all to use technology to increase quality or to reduce costs.

My plea to you is this: if you really believe that technology has something to offer kids who are at risk, or to any other kids in the system, think very carefully about how to use technology effectively. Think about the structure of public policy and the incentives that it provides the people in our schools. I firmly believe that the whole thrust of most public policy these days, from one end of this country to the other, is not toward using technology to reduce costs, to improve quality, or to help at-risk kids. If you don't solve that problem, and revise the thrust of public policy, nothing else you do is going to make any difference at all. Thank you.

Conference Synthesis

Duncan Green
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Ontario Ministry of Education

Some are born great, some achieve greatness, and some have greatness thrust upon them. I'm in the last category, and you will be the determiners of the greatness. I hope I will be more successful than our baseball team; I understand from Jim Hrabi that the team lost 15 to 14 to the Yankees last night. That says some-thing about relief pitching, and as a relief pitcher I feel singularly vulnerable this morning.

I think perhaps you should know a little more of my qualities, particularly in respect to the topic of the conference. Last Saturday evening my wife and I visited a friend who is just out of the hospital. He and his wife are relatively confined to an apartment; and because he is extremely fond of movies, we rented some, along with a VCR, and planned to spend a pleasant evening that would take his mind off his illness. I couldn't hook up the VCR and he couldn't hook up the VCR. Two singularly unproductive hours went by while we explored the labyrinths of educational technology. Meantime our wives, coaching from the side, had a really pleasant visit.

You should also know that I face the purchase of a new automobile with the greatest sinking feeling known to man. I almost hope the odometer will stop on the one I own because I hate going through the purchasing process. I don't like the brochures; they're not my idea of grabby reading.

I don't have a bank card that lets you use the instant deposit/withdrawal machines. I discovered that all they enable you to do is line up outside instead of inside and decided there was no particular advantage. Also, as my wife said, "If you think I'm putting money into that thing, you're crazy."

On the other hand, I have two kids who are, by most standards, computer literate, and I have watched them do things with those machines that leave my mind a little boggled. The arrogance that follows that isn't too palatable, as they condescend to try to explain to this technological illiterate what they are doing.

I have seen technology overcome difficulties in organizations. I will use one or two parochial, local examples, if you don't mind, and I apologize for those but I have to speak of what I know. We have strong incentives to change. We've always debated whether terror or love is the greatest incentive. In school systems we tend to alternate between the two. One of our school systems is a very small school system with one large secondary school, required to deal with both language groups in the province, French and English.

school, required to deal with both language groups in the province, French and English. That system's incentive to move to technology was self preservation. The enrollment had reached a point where the school was no longer able to sustain a teaching staff sufficient to provide even the minimum number of options. So administrators and teachers were driven into a different form of organization—driven into it—not with their eyes closed, but with some sense of what they were getting into.

The technologies that they employed had the computer at the end of the line and a Xerox machine at the front of it. The first technology employed Xerox because they modularized their curriculum and duplicated the modules for student use. The second technology involved the expanded use of an audiovisual center that, in previous incarnations, had been active only on Friday afternoons into one used all week long. After the school had been operating in its new mode for about three months, the person responsible for that center said that for the first time the material was being used the way it is supposed to be used—with the kids determining its use. That individual, by the way, achieved significantly more status in the school because he was able to coach kids directly and to help them to exploit the technology effectively. The third piece of technology the system acquired, since it was in a remote part of the province, was a satellite dish.

There and elsewhere we have succeeded, by using technology, in broadening horizons for kids. The most exciting example was at Pickle Lake (about 500 kilometers north of the north shore of Lake Superior) on the Native reserve, where there is no electricity and the computers that the kids have access to are operated on a portable generator. There is something paradoxical in the situation, but it is fascinating to observe.

You see, then, my own primitive technological state, and yet I freely acknowledge that technology can bring many enrichments to the educational experience.

This conference was intended for those who affect educational policy on the state and provincial level. Now some of you may be surprised by your attendance here. Indeed I am surprised by my own. It always comes as a surprise to me at home to discover that anybody has thought that I affected policy, and certainly it comes as a surprise to me in the middle of the night when I reflect on the activities of the day. It doesn't seem to me that I've made a dent. However, the conference was intended for policymakers, and although that accounts in part for the absence of certain groups that some might have anticipated would be here, I don't think that the conference organizers need to make any apologies.

So there may be relatively few classroom teachers, there may be relatively few representatives from business and industry, there may be relatively few local employers, there are probably no students and certainly no students at risk.

AIT then has undertaken to see how the area of activity for which it has a major concern—instructional technology—could best be used to address the needs of students identified as a national priority. These are students at risk. I should explain that in my part of Canada we still call them "dropouts." Students at risk are often special education students. The blurring of those two definitions makes life difficult for people who want neat classifications.

So, that was the intent, and it brought together a disparate group of participants that I've tried rather dangerously to categorize into about four groups. First, there are the technology enthusiasts—the ones who sleep with their computers, or, near as I can gather, don't sleep at all. Second, there are the technology novices, such as myself—those I parenthetically call "skeptics[?]" These are people who have watched our mixed success with instructional television. These are the people who watched the school board's reaction to ballpoint pens when those were first introduced. The school system banned them, but nevertheless, at Christmas all the parents gave the kids ballpoint pens and the school system had to surrender. It did the same, by the way, with calculators. So they are the skeptics.

The third group are the advocates of students at risk. I have the feeling that one or two were surprised to find themselves, all of a sudden, pressed into service for a state priority. But there is a significant number of people who are recognizing that the educational establishment does not adequately serve the at-risk population, and feeling that perhaps a parallel or even a different structure should be established for that population, accepted the role quite willingly.

Finally, there are those groups of people who are charged, either positively or negatively, with policy development. They range from those who welcome the opportunity to see how things can be brought together under one umbrella to those who sing "Oh my God, don't tell me we've got to address **that**, too." Those are roughly the four groups as they emerged in the small group discussions: the enthusiasts, the novices or skeptics[?], the advocates, and the policymakers.

We have been provided with a context. In the first part of the context you saw a dramatic demonstration of technological effectiveness. I was really impressed with that demonstration. It had a nice human touch to it, too. Do you remember the long pause before one slide came on the screen, and do you remember the sigh of relief that everybody breathed when it finally did appear? Perfection has not yet been achieved. Human error still exists. "Thank God," we said, "they make mistakes too." Not withstanding that one slight delay—which, I argue, injected a very necessary human component to the enterprise—it was an overwhelmingly powerful demonstration of an overwhelmingly powerful set of tools. We know what can be done. The reason for doing it was rather dramatically demonstrated by Mr. Hodgkinson, who dealt not just with students at risk but with a nation at risk. That, by the way, has across-the-border implications; for those of you who didn't know, about 80% our population in Canada lives within a hundred miles of your border. (We're keeping the rest of the land up North until you get too fractious and then we're all gonna move.)

We have all been provided with a political imperative. There is no question but that we in Canada are subject to exactly the same demographics as you. Our country, like your country, is wrestling with the immigrant problem. And we are wrestling with ourselves because Canada has been a traditional haven for the disaffected, and for the deprived. We are grappling with the same problems you are in the context of our own economic situation, and our own social situation. We have been provided with graphic, articulate representations of how technology may be applied to solve our many problems.

There are a couple of major overrides on the conference. There was a tentative, and in some cases, reluctant, acceptance of the definitions of "students at risk" and "technology." In two of the four sessions that I visited, it was indicated that conspicuous in its absence among the listing of the characteristics of student at risk was inadequate teaching. Nobody really wanted to talk about that. It was always the home situation, it was never what the school had done. As one participant put it, "I don't think we should exonerate the schools quite so completely as we identify the criteria." There was also that worry about whether you put the box around special education and the handicapped or whether you don't. But I think these were basically minor quibbles in terms of the total thrust of the enterprise. There was also a tendency to identify technology to a great degree with computers. But by and large, people accepted those definitions as working definitions.

Second, there seemed to be general agreement on the incredible motivational advantages, particularly of the computer and of the videodisc. People are quite ready to accept that and recognize that this motivational power must be exploited.

In one of the sessions someone asked that pointed question: "How many of the people around this room have a computer on their desks and use it?" Fewer than half identified themselves in that capacity. I have reached the stage in my career where I'm figuring I might just be able to escape before they put one on my desk. The implication is that few people are so computer friendly, or technologically friendly, as we expect teachers should be. Teachers are people, too. It may be this is a factor that we should take into consideration in our comments.

It has been suggested that I will sum up the main ideas and the main principles and provide the recommendations. I found this a rather formidable task, but I'll try. I have identified six main ideas, eight principles that I think were articulated in the small groups and by the speakers, and I've had the nerve to propose five recommendations. These last are in the passive voice, which does not identify an agent for their implementation. I'm assuming that that will be the product of the meeting in the fall.

The main ideas which emerged appeared to me to be the following.

First, there is a strong belief in the potential of technology, in its ability to enrich the educational experience of all students and to provide what someone called a "value-added curriculum." So we all have faith. You may find its manifestations in different churches, but we all believe.

Second, technology can enrich the educational experience of all students, not just students at risk, although the motivating power and flexible use of that technology may be particularly effective when it is employed to address this group of students.

Third, there is some concern that the at-risk group has been defined too late, if it is defined only within the context of the school-age population. People continually referred to the need for earlier interventions, particularly with special populations.

Fourth, teachers are not well-prepared to grapple with the effective use of technology with their own programs; more adequate in-service opportunities must be orchestrated to enable them to exploit its use.

Fifth, the effective application of technology has major implications for the traditional organizational structure of schools. I have described one school in our own jurisdiction that has made accommodations this way. I would anticipate that almost everyone in the room could point to a similar kind of school. They are not yet, however, reaching the point where they are the models of school organizations to be imitated broadly.

Sixth, technology can provide really effective communication between individuals and agencies about students at risk. If I may make a personal comment here: I get a little nervous with everybody's enthusiasm for the documenting of a student's past and the exchange of information about that student. We're going in two directions at the same time: we have freedom-of-information legislation moving through on the one side, and challenges to invasion of privacy in the courts on the other side. I'm not sure where we're going to come out, but this whole business of freely exchanging information, including psychological test scores, etc., has an awful aura of big brotherness to me. I've often thought it would be sufficient to use the technology to say to somebody "Hey we've got this kid, we know him, do you want to talk some time?" Maybe that's all it will be used for. But there was agreement that technology had real potential for providing profiles that could lead to presumably salutary activities.

When it came to the principles which should inform application of technology, I identified the following. The first, and I found this the most persuasive and best articulated, was that **technology should be used to empower students, especially those at risk, rather than to enslave them.** The uses we make of it should be emancipating. I thought, incidentally, that that distinction might be a difficult one to make. I was totally persuaded by the "fluency" argument in the first presentation. I found their method of using technology to increase fluency a useful one. If we are going to profit from and enjoy tennis, we do seem to have to go through that horrible period when we have to practice our serve if we're going to serve effectively. The pleasures from the practice come later. So there is a period of time when the enslavement does seem to dominate the emancipation. We must keep in mind that empowering is the long-run goal.

Second, the principles of good pedagogy should apply in the exploitation of technology to enhance the educational experience. Technology should produce engaged and not passive students. That speaks, by the way, specifically to the computer and to the videodisc instead of the straight AV presentation, unless the VCRs have interactive capability.

Third, and this is particularly true in connection with software development, we were urged everywhere that I went to **work closely with school districts to insure that programs are consistent with curriculum objectives**, with local curriculum objectives. That runs counter to IBM's marketing principles, which are to cast as wide a net as possible; so there is a potential tension between software producers and those who want material that they can modify for use in particular classrooms. (In our own province, we have undertaken a major route in this direction by underwriting the production of software. It's an expensive proposition; on the other hand, it has produced some incredible material.)

Fourth, technology should be applied in such a fashion as to increase the positive relationship between students and teachers and adults. Most people commented on the bias-free capabilities of the technology—the suspension of judgment, the ability for people to use it and make mistakes without feeling stupid or ashamed. It's that sort of supportive atmosphere that seemed to be one of the principles that people felt should underlie the software as it went along.

Fifth, for its effective use there must be a commitment to investment and to the correct timing of the introduction of technology with "due regard for local control." I knew I was right at home when I heard that "due regard for local control."

Sixth, technological applications must be seen as systemic. By that it was meant that teachers have to be prepared, by pre-service training, to use technology. That means, of course, if you go all the way back to the seed and origins, the professors and faculties of education have to be involved in the thinking about technology. And training in the uses of technology must form an integral part of the in-service activities of teachers; this training should be considered in conjunction with a careful review of the curriculum and its restructuring. It was also emphasized that technology should permeate, not dominate, the learning process.

Seventh, the application and exploitation of technology must not be seen as a panacea. The best phrase I heard came from one of the discussion groups. The comment was "keep the hype down and the humility up." Recognize the limitations of technology; don't promise too much; and, particularly, don't leave the impression that technology alone is going to solve the problems of students at risk.

Eighth, the equality of access to the benefits of technological application must be assured. I think this was brought up particularly in conjunction with the at-risk students, because they have been, according to a number of those in the small groups, often excluded from the effective use of technology. It's as if nobody trusts them to punch the keys. I was surprised by the extent to which this concern emerged. I don't know how general it is. I don't think (I'm saying this while crossing my fingers) it is characteristic of our own school systems at home, but I could very well be wrong; no doubt after I sit down someone will tell me that I am.

Now, the dangerous part—the recommendations. Those of you who bought the *New York Times* yesterday may have seen on the front of the second section a really interesting article. This was the opening paragraph

> Nearly a generation after American technology companies unleashed new computers, telecommunications gear and electronics equipment, executives and employees are discovering that [instead of saving labor] the sophisticated machines in many cases have been hampering their work.

It goes on to document this with a number of companies: Federal Express is one that comes to mind. Then, mid-way down, was the following paragraph, which I found singularly appropriate to the deliberations of this conference.

> In interviews discussing service—productivity problems economists and business executives identified three principle causes: [first,] many managers and employees still lack the knowledge to use computers and electronic hardware effectively.

(I thought that said something about the comments that people were making about the state of teacher preparation, and my own preparation, for that matter.)

> [Second,] supervisors have failed to develop management techniques to take advantage of the new technology.

(I thought that said something about school organizations, school structures.)

> [Third,] the equipment still suffers from reliability problems.[1]

I thought that said something about the software and its relationship to curriculum objectives, and so forth. So, because misery loves company and I could look to the American icon, the business sector, for my guidance, I would find that the recommendations coming out of the groups in this conference are coincidental with the recommendations that presumably will be coming out of the business arena. I commend to your attention the article in yesterday's *New York Times* as a useful guide in the implementation process, as these recommendations are considered.

The first is that pre-service and in-service activities have to be provided to prepare teachers to exploit the technology effectively, and this has to be a continuing process. I'm not naive in this connection by the way. I know the time negotiation problems—you can't do it in the holidays, you can't do it in the time allotted to instructional purposes, and you can't do it after school or at night. That doesn't leave a lot of time. One of our own ambitions at home is to try to negotiate an understanding of whose responsibility is what in this connection. I think there are four parts in that equation. There are the individual teachers; there is the teachers' employer, (in our case the school board); there is a collectivity of teachers who have a self-interest in the image of the profession, and more than a self interest, they should have a societal interest in the image of the profession; and finally, there is, the state or provincial education agency which sets a lot of the requirements.

Second, teachers must be led gently to the use of technology rather than having it thrust upon them from above, or it will not be effectively employed.

Third, there's a need for greater research to validate the claims that technological application does make a difference in the educational process, especially for students at risk of school failure. The short-term research may be there, with recommendations for certain strategies which appear to have produced impressive gains in specific areas, but long-term findings are what people are a little bit skeptical about. They are concerned about the expense of such research and what agency should undertake it. A number felt that AIT perhaps was an appropriate agency to do this.

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[1] Keith Schneider, "Services Hurt by Technology," *New York Times*, 29 June 1987, Sec. D.

Fourth, software development should be undertaken in closer cooperation with teachers of students at risk and with local curriculum authorities. There is a sense in people's minds that buying off the shelf sometimes didn't work; the pants didn't quite fit. The need to tailor software programs is important. Here I think people felt that AIT might be able to perform the role of broker between industry and the consumers of this product.

And finally—you'll notice the passive voice in this one—the question of adequate resources must be addressed. Necessary resources will be substantial enough that this question would appear to need addressing at the state or provincial level, or even at the national level. The application of technology on any broad front is so expensive that local resources are not adequate to fund an on-going strategy. How this is to be marshalled is less easy to identify.

I have done my best to summarize what I have perceived to be the main ideas, underlying principles, and recommendations that AIT will then transmit to appropriate authorities. Thank you.

Stephen S. Kaagan
Vermont Commissoner of Education,
Chairman, AIT Board of Directors

Next Steps

Duncan Green has made my task a lot easier than I thought it was going to be. He did an excellent job. I have one resentment about his work that I will share with you at the end, but other than that he did a fantastic job, I think, in summing up. As I think back over the last couple of days, I feel a fair amount of satisfaction, frankly, and a fair amount of enjoyment in the proceedings. I think I have learned something, and it's not often that one, particularly one who has been as closely involved as I have, can say that about a conference. One of the things I have enjoyed most has been the opportunity to talk about technology without the domineering presence of tables full of hardware and software. It is very unusual to have the opportunity just to talk about, and think about, the uses of technology. As I said in my opening remarks, one of the most important things we can do is think about the uses of technology before we actually use technology.

I was very pleased by all the critical comments that people shared with me. There was not, they said, enough free time, not enough interaction. There were also concerns about who was here and who was not here, as presenters or participants. There were concerns about our pedagogy. We did not provide everybody with a portable microcomputer so that they could take notes. As always in a conference, there were concerns about whether or not we did what we said we would do. All of these concerns give me a great deal of satisfaction. They suggest that while we are doing a lot of things right, we are still in process; they suggest that people felt some positive things, but that they also sensed a lack of completeness, and that's good.

I have only a couple of points to add to what Duncan Green said. First, I hope you will all agree that this conference has advanced our thinking about technology along the continuum from nice to necessary. I hope we have been able to achieve that. Secondly, I hope that the exigencies talked about in this conference are now more deeply felt and thoroughly understood. First is the exigency that appears on the title of this conference, students at risk of school failure. As the conference proceeded, I found myself redefining that group of students. I came in with certain assumptions about at-risk students, and I learned some important things, particularly from Bransford and Hasselbring. What they did was, by my definition, real science. They showed us how to use technology appropriately. From them and others I learned that students who are at risk are short on motivation. They are "encumbered" when it comes to acquiring skills leading to fluency. They have been deprived of the contacts that serve as background for learning, and they are provided with fewer opportunities than their peers to perform successfully. I redefined at-risk students for myself here, and I think that one of the more useful things that we, as policy setters, can do is continually redefine this group and their special needs.

Duncan noted four groups involved in the very important job of teacher preparation, both preservice and inservice: localities, the teachers themselves, state entities, and administrators and policy setters in departments of education. I would add to these a fifth entity– the universities. I wonder for myself how that entity to which we have delegated a large portion of the responsibility for teacher preparation will cooperate with us in understanding the problems and in arriving at solutions.

Finally, a question which came up over and over again in the small groups in a variety of guises was the question of whether at-risk students should be treated differentially– or differently– from other students. Should a new category of exceptionality be established? I happen to think that this will be a serious policy question in any number of forums in the next couple of years, at state and possibly federal levels, and I hope, a question not just dependent on the outcome of some elections. One wonderful comment in one of the small groups was "Can we possibly separate out the educational from the political? Isn't there some way we could designate this group, politically, to get the money to deal with them, but at the same time avoid the educational disadvantages of categorizing this group?" I thought that was a very impressive statement of the plight. Unfortunately, the answer is "No, we can't. Sorry." I don't think there's any way that we're going to be able to separate the political from the educational. One person asked the question, "Does this difference, if it exists between kids who are at risk and those who are not, redound to the present and future uses of technology in education?" I think "probably not" is the answer. I think that's where that plaintive cry was coming from, the use of at-risk students increased your attentiveness to the subject of this conference add to potential solutions in dealing with the problem.

What are the next steps, or some of them? About twenty people have asked me whether or not we are going to do any fair rendering of the various presentations of the conference. And the answer is "yes, we are." The initial thought is to first put together some verbatim transcripts and then to do some editing of those transcripts. Any of you who have had the wonderful experience of reading what you have said and trying to decipher it will understand why some editing is necessary. You say to yourself as you read it, "Did I say that? That doesn't make any sense." We will put together conference proceedings. In those proceedings there will be, we hope, well-edited transcripts of the presentations. Some of that already exists and we intend to use those conference proceedings in a number of different forms. I said to you at the beginning of the conference that it is AIT's intention to conceptualize and carry out, if it is possible and desirable, and appropriate, a project. AIT has allocated a certain amount of money in next year's budget to do that exploration, with the intention that by 1990 a real set of products will exist– AIT products designed especially for at-risk students. That's an important outgrowth of this conference. It means that what you talked about will have an impact in a very tangible way.

In talking with a number of people, I also see on the horizon some possibilities for interesting joint ventures, perhaps with private entities, perhaps with public entities. There has been a lot of discussion here of possible joint ventures between AIT and other organizations, or between some subsets of the groups represented here and other organizations. I also think that one of the ground-breaking things that we have done here is to show the need for much more finely tuned interactions between educators and vendors. Educators are those who sell in the marketplace materials for use in the schools. Now that's always been true, I know, but I think we have demonstrated that because we have been largely a talk conference; we've been a conference that's been conceptual rather than one that's said, "Here's the hardware, do you want it or not; here's the software, do you want it or not." I think that we've not only demonstrated a need for more discussion between educators and vendors, but that we also have some responsibility to follow up on that need.

As I said in my remarks earlier, we—AIT representatives, board members and others—intend to have at least some degree of participation in the political drama (and it is indeed a political drama) that will unfold in this country regarding at-risk students. There are so many important actors making serious considerations of our more dire problems; they are not so much thinking of the students themselves, but of the problems that result if they are not given the motivation, direction, and skills to be productive members of society. And I hope that technology can be an ingredient in those considerations. Your responsibility is still there. I hope that as states and provinces you will find the will—if not, we will provoke it—to respond to us by September with what you think are the most important ways technology can be used to help God and AIT in their work. I hope you have learned something here and I hope it will be reflected in some of what you send us in writing by September—we hope in the form of short, crisp, concise, articulate, cogent letters.

My one resentment with Duncan's presentation, and I'll end here, was that he used the *New York Times* article. I was going to use it. I wanted to use it because the first thing I thought about when I read it was another comment from Daniel Boorstin's book, *The Discoverers*, where he talked about the introduction of moveable type. I had never known this, but he said that the first twenty-five to fifty years after the introduction of moveable type were the greatest heyday of the scribes. It struck me that we have something to learn from that. There has never been the even-handed, symmetrical, progressive introduction of technology in human affairs. Only eventually does the penny drop and the impact is felt. Let it be said that we get ahead of rather than being behind it. Thank you very much for being here. We enjoyed it as I hope you did, and I hope you learned something.

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Executive Director
Canadian Education Association

Executive director since 1981, Mr. Blair was formerly assistant executive director of the Canadian Education Association.

Unique in North America and perhaps in the world, the apolitical organization includes in its membership elected local school trustees, senior officials from local school boards and ministries of education across the country, members of postsecondary faculties of education, and representatives of various other professional education organizations, including teachers' associations.

Because Canada has no federal office of education, the association exists to provide sharing of information among the ten provinces and two territories. It serves as a central source of information on education, publishing factual information and bringing all the members together in in a neutral forum on a regular basis, at seminars and its annual convention. Recently, it has conducted a seminar on technology and education, bringing together school board trustees and officials and experts in the new technology. It has published a report called *The Electronic Classroom.* It regularly brings together the chief executive officers of the large city boards of education to discuss technology in education.

Mr. Blair is a graduate of Queens University.

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Director, Learning Technology Center
George Peabody College for Teachers, Vanderbilt University

Professor of psychology and of education, Dr. Bransford has published extensively in the fields of psychology and education and has written numerous research articles and books. He is recognized internationally for his work on thinking and learning. Most recently, his research has focused on issues of thinking, learning, and problem solving with children who have learning problems, and on ways technology can be used to help these children overcome difficulties in learning.

He received his doctorate in cognitive psychology from the University of Minnesota in 1970.

Duncan Green
Assistant Deputy Minister of Education
Ontario

Since 1983 Mr. Green has been assistant deputy, learning programs (secondary and elementary education), in the Ontario Ministry of Education.

He was previously director of the School of Continuing Studies and professor of the faculty of education at the University of Toronto; Ontario chairman of the Secondary

Education Review Project; and director of education with the City of Toronto Board of Education.

He is a member of the Canadian Education Association, the Business Education Relations Committee of the Metro Toronto Board of Trade, and the Urban Alliance for Race Relations.

He has been president of the English section, Ontario Educational Association, and chairman of the Joint Council on Education, University of Toronto and Ontario Institute for Studies in Education, and has served on the Board of Governors, Ontario Institute for Studies in Education.

He hold the B.A. in English from the University of Toronto.

Richard R. Green
Superintendent
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A member of the Harvard Graduate School of Education Visiting Committee and president of the Council of the Great City Schools, Dr. Green is former president of Large City School Superintendents and has served the National Commission on Secondary Schooling for Hispanics, the Network for Instructional Television board of directors, the Edward W. Hazen Foundation board of directors, and the Institute for Ecumenical and Cultural Research.

He began his career in education with students at risk, teaching special education classes. Later administrative assistant for desegregation/integration in the Minneapolis Public Schools, he was assigned in 1973 to the MPS Research Project on Racism. Among his publications is *Human Relations: a Response to Racism through Curriculum Educational Leadership*.

The Minnesota Association of School Administrators honored him with its 1986 Administrator of Excellence Award.

He holds the B.A. from Augsburg College, the M.S. in special education from St. Cloud State College, and the Ed.D. from Harvard University.

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Associate professor in the department of special education, Dr. Hasselbring has been involved in research in the use of computer technology with handicapped individuals since 1972. Most recently, he has been actively involved in studying the use of technology for developing basic skills fluency in children with learning problems. He has written more than fifty journal articles, book chapters, and technical papers on his work and has been recognized for his work in software development.

He received his doctorate from Indiana University in 1979 with a major in abnormal development and a minor in educational research.

Harold L. Hodgkinson
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Dr. Hodgkinson is currently conducting research on demographics and education for several foundations. In 1983-84 he held a federal fellowship to study collaboration between business, higher education, and public schools. Before that he was president of National Training Laboratories, director of American Management Associations, and director of the National Institute of Education.

He has directed eight major research projects, including the Institution in Transition study for Carnegie Commission, the Study of Developing Institutions for the U.S. Office of Education, and projects for the Exxon, Ford, and Atlantic Richfield Foundations. He has been a consultant to colleges and universities, public school systems, state agencies, state legislatures, cities, and corporations such as 3M, Federal Express, and General Motors.

Three of his twelve books have won national awards, and the American Education Press Association has honored him for his more than 200 articles. He has lectured widely and edited the *Harvard Educational Review* and the *Journal of Higher Education.* In 1984 he was named by Secretary Bell to the National Study Group on Excellence in Education, which produced "Involvement in Learning."

His undergraduate degree is from the University of Minnesota, his master's from Wesleyan, and his doctorate from Harvard.

David W. Hornbeck
Superintendent of Schools
Maryland

Now in his third term, Mr. Hornbeck administers Maryland's State Department of Education, which includes vocational rehabilitation, public libraries, and instructional television, in addition to general education, special education, vocational education, and other programs.

Initiatives undertaken since his appointment include Project Basic, Maryland's statewide competency-based education program. He has vigorously supported improvements in special education and early childhood education; programs for the disadvantaged and unemployed youth, gifted and talented programs, programs for adults (such as the external diploma), the Maryland Professional Development Academy, multi-service educational centers, guidance and counseling, and teacher quality. He is a national leader in pressing for wider use of sophisticated educational technology.

President of the Council of Chief State School Officers, he also is vice chairman of the board of the Carnegie Foundation for the Advancement of Teaching and a member of the board of the Joint Council on Economic Education. He serves on the Carnegie Council on Adolescent Development; the W.T. Grant Foundation Commission on Work, Family, and Citizenship; The Cleveland Conference; and the Education Commission of the States.

He holds an undergraduate degree from Austin College in Texas, a Diploma in Theology from Oxford University, and the Bachelor of Divinity from Union Theological Seminary. He was graduated from the Law School of the University of Pennsylvania.

Stephen S. Kaagan
Commissioner of Education
Vermont

Dr. Kaagan chairs the Agency for Instructional Technology's board of directors. He also serves on the executive board of the Center for Policy Research in Education of the Eagleton Institute; the board of directors of the Council of Chief State School Officers; the board of directors of Very Special Arts, Inc.; and a national advisory panel of the National Educational Longitudinal Study (NELS '88).

In Vermont, he secured statewide support for revised standards for approving the public schools; led the development of an early education initiative, including the establishment of a state requirement making kindergarten accessible to all five-year-olds; established special opportunities for motivated and talented high school students in the arts, science, and international affairs; and restructured the department to provide greater service to local school districts and more professional development opportunities for educators.

Earlier, he was provost of Pratt Institute; consultant, Massachusetts Council on the Arts and Humanities; and deputy commissioner, Massachusetts Department of Education.

He served recently on the National Academy of Sciences Panel to Evaluate the National Center for Education Statistics. The panel's report, "Creating a Center for Education Statistics: A Time for Action," was issued in October 1986.

He holds the A.B. from Williams College and the M.A.T. and Ed.D. from Harvard University.

Bernard J. Shapiro
Deputy Minister of Education
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Past president of the Canadian Society for the Study of Education and the Social Science Federation of Canada, Dr. Shapiro serves on the National Advisory Committee Statistics Canada—Education Statistics and the board of directors of the Canadian Education Association.

He has been director of the Ontario Institute for Studies in Education; vice president (academic), provost, professor of education, and dean of the faculty of education at the University of Western Ontario; and professor of education, associate dean of the school of education, and chairman of the department of humanistic and behavioral studies at Boston University.

A number of his many publications focus on curriculum, basic skills development, and methods of instruction for children with retardation and learning disabilities.

In 1986, he addressed the World Congress on Education and Technology on "Education and Technology: Planning for Research."

He holds the B.A. in political science and economics from McGill University and the M.A.T. in social science and Ed. D. in measurement and statistics from Harvard.

James P. Shea
Manager, Research and Evaluation
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A professional evaluator for nearly ten years, Mr. Shea has conducted evaluations of instructional television and computer materials in many curricular areas with age groups from preschool children to adults. Before working with instructional technology, he was a project evaluator/documentor for a federally funded Teacher Corps project at Indiana University.

He holds a bachelor's degree in psychology, with additional concentrations in mathematics and computer science, and a master's in educational psychology, with additional work in research, evaluation, psychometry, and curriculum design. Both degrees are from Indiana University.

Marc S. Tucker
Executive Director
Carnegie Forum on Education and the Economy

A program of Carnegie Corporation of New York, the Forum was established to provide policy leadership on national education issues. It conducts analyses of the relationship between education and the performance of the American economy, and assembles groups of leading Americans to develop policy proposals on specific problems. These proposals are presented each spring at the annual meeting of the Forum. In May 1987, the Forum released its first report, *A Nation Prepared: Teachers for the 21st Century*, the work of its Task Force on Teaching as a Profession.

Before joining Carnegie Corporation, Mr. Tucker conducted research on the use of computers and telecommunications technology in education, under a grant from Carnegie Corporation. From 1972 to 1981, he was at the National Institute of Education, where he served as associate director for education policy and organization.

During his career, he has been involved in mathematics and science curriculum development, technical assistance programs serving the needs of low-income communities, and educational broadcasting.

He was educated at Brown, Yale, and George Washington universities.

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